a. General

Gender:

1aG: What is your gender? (multiple-choice) [Female, Male, Transgender, I prefer not to answer, Other (free text)[1]] [8]

2aG: Please specify the gender with which you most closely identify. [Male, Female, Other, Prefer not to answer] [27][14][2][42][56][61]

3aG: Please tell us your gender. [Female, Male, Other (please specify), Decline to say] [43]

4aG: Gender: [Female, Male, Other, Prefer not to say] [35][10][2][12][14][61]

5aG: Gender: [Male, Female, Prefer not to answer] [44]

6aG: What is your gender? (free text) [4][36][31][11]

7aG: To which gender identity do you most identify? (single choice) [Female, Non-binary, Male, Prefer not to say][24]

8aG: Gender [41]

9aG: Please enter your gender: [33]

10aG: Please select your gender. [Female / Male / Prefer not to say / Diverse: (free text)] [57][1]

11aG: Please select your gender. [Female / Male / Other / Prefer not to say] [14][61]

12aG: What is your gender? [Male, Female, Other, Prefer not to answer] [20]

13aG: What is your gender? [Male, Female, Non-binary, Other (please specify), Prefer not to say] [9]

14aG: What is your gender? [Male, Female, I don’t want to answer] [38]

15aG: Please specify the gender with which you most closely identify. [Male, Female, Other, Prefer not to answer] [29]

Age:

1aA: What is your age? (multiple-choice) [18-24, 25-34, 35-44, 45-54, 55-64, 65 or older, I prefer not to answer] [8][10][34][2]

2aA: Please specify your age. [18-29, 30-39, 40-49, 50-59, 60-69, Over 70] [27][42][56]

3aA: How old are you? (free text, check that the answer is a number) [43][4][44][12][16][5][31]

4aA: How old are you? [18-25, 26-35, 36-45, 46-55, 56-65, Over 65, I do not wish to disclose] [11]

5aA: Age [41][14][1][61]

6aA: Please enter your age: [33]

7aA: Age (Number) [57]

8aA: What is your age? [36][20]

9aA: Please enter current age in years, in a number format (if you'd prefer not to say, enter 0): [9]

10aA: How old are you? Enter 0 if you don't want to answer [38]

11aA: Please specify your age. [18-29, 30-39, 40-49, 50-59, 60-69, Over 70, Prefer not to answer][29]

Ethnicity, Language:

1aE: Please specify your ethnicity. Select all that apply [White, Hispanic or Latino, Black or African American, American Indian or Alaska Native, Asian/Native Hawaiian/Pacific Islander, Other] [27] [42] [56]

2aE What is the main spoken language you use at work? (single choice) [English, Chinese, Spanish, Arabic, German, French, Other] [24]

3aE: What is your native language (mother tongue)? (list of languages) [20]

4aE: Please specify your ethnicity. [Hispanic or Latino, Black or African American, White, American Indian or Alaska Native, Asian, Native Hawaiian, or Pacific Islander, Other, Prefer not to answer] [29]

Country, State:

1aC: In what country do you work? (multiple-choice) [Australia, Canada, Germany, India, United Kingdom, United States, Other (free text) [8]

2aC: In what country do you work? (free text) [4][34]

3aC: What country/countries do you live in / which country/ countries are you a citizen of? (dropdown) [43][12]

4aC: Please specify which country/state/province you live in. [42]

5aC: Where are you from? [36]

6aC: In which country do you currently reside? (single choice) [24]

7aC: In what state do you work? (multiple choice) [8]

8aC: Which state do you live in? [11]

9aC: What is your nationality? (free text) [14][57][1][61]

10aC: What country do you live in? (free text) [61] (dropdown)[54][1] 61(Exit survey)

11aC: What country did you (primarily) grow up in? (list of countries) [20]

Income:

1aI: Please specify the range which most closely matches your total, pre-tax, personal income specifically from vulnerability discovery in 2016/2017. [<$999, $1,000 - $4,999, $5,000 - $14,999, $15,000 - $29,999, $30,000-$49,999, $50,000-$74,999, $75,000-$99,999, $100,000-$124,999, $125,000-$149,999, $150,000-$199,999, >$200,000, Prefer not to answer] [27][42]

2aI: Please specify the range which most closely matches your total, pre-tax, household income in 2016. [< $29,999, $30,000-$49,999, $50,000-$74,999, $75,000- $99,999, $100,000-$124,999, $125,000-$149,999, $150,000-$199,999, > $200,000] [42]

3aI: What is your annual income? [Less than $25,000, $25,000 to $34,999, $35,000 to $49,999, $50,000 to $74,999, $75,000 to $99,999, $100,000 to $124,999, $125,000 to $149,999, $150,000 or more][11]

4aI: Please specify the range which most closely matches your total, pre-tax, personal income specifically from software development last year. [< $999, $1,000-$4,999, $5,000-$14,999, $15,000-$29,999, $30,000-$49,999, $50,000-$74,999, $75,000-$99,999, $100,000-$124,999, $125,000-$149,999, $150,000-$199,999, > $200,000, Prefer not to answer] [56]

Education and Background:

Study subject, university, semester:

1aS: What is your study subject? (only displayed for participants who are either Bachelor, Master or Diploma student) [16]

2aS: What was the subject area of your highest level of education (if above high school)? [11]

3aS: If you are currently a student or have completed a college degree, please specify your field(s) of study (e.g. Biology, Computer Science, etc) [27][42][56]

4aS: In which program are you currently enrolled? [Bachelor Computer Science, Master Computer Science, Other:] [35][14][61]

5aS: What is your major? Please select one answer. [Cyber Security, Electrical Engineering, Computer Science, Other: (free text)] [5]

6aS: Do you have an IT-security background? If yes, please specify. [43, 41]

7aS: Your semester: [35][5][33][14][61]

8aS: Which university are you at? [University of Bonn, Other:] [35][14][61]

9aS: Which university are you at? [33]

10aS: At which university are you currently enrolled? [University of Bonn, University of Aachen] [14][61]

11aS: Do you have a university degree? [Yes, No] [57]
If yes:
- At which university/universities were/are you enrolled? (free text)
- What was/is your subject? (free text)
- Were/Are you taught about IT-security at university? [Yes, No, I don’t recall]
- If yes:
  - Which security lectures did you pass in your Bachelor/Master programme? (Free text)

Was at least one of these modules a compulsary Module? [Yes, No, I don't recall]
Were/Are you taught about IT-security apart from university? [Yes, No]

If yes:

Where were/are you taught about IT-security apart from university? (free text)
What was your main source of learning about ITsecurity? (Free text)

If no:

How did you gain your IT skills? (Free text)
How did you gain your IT-security skills? (Free text)

12aS: Which security lectures did you pass in your Bachelor/Master programme? (dropdown/other: (free text))[14][1][61]

13aS: Do you have a university degree? [Yes, No] [61] [1]

14aS: At which university/universities were/are you enrolled? (free text) [61][1]

15aS: What was/is your subject? (free text) [61][1]

16aS: Were/Are you taught about IT-security at university? [Yes, No, I don't recall.] [61][1]

17aS: Were/Are you taught about IT-security extramural? [Yes, No]
If yes: Where were/are you taught about IT-security extramural? (free text) 61(Exit survey)

18aS: Where were/are you taught about IT-security apart from university? [1]

19aS: What was your main source of learning about ITsecurity? (free text) [61][1]

20aS: How did you gain your IT skills? (free text) [61][1]

21aS: How did you gain your IT-security skills? (free text) [61][1]

22aS: How many years formal or informal training have you received? This includes schooling, industry training programs, and work-specific training programs. (number) [29]

Education:

1aEd: What is your position? [Bachelor student, Master student, Diploma student, PhD student, Post Doc, Professor, Other:] [16]

2aEd: What is the highest degree or level of school that you have completed? (multiple-choice) [Professional doctorate (for example, MD, JD, DDS, DVM, LLB), Doctoral degree (for example, PhD, EdD), Masters degree (for example, MS, MBA, MEng, MA, MEd, MSW), Bachelor (for

example, BS, BA; also German Berufsausbildung), Associates Degree (or German Abitur), Some college, no degree – Technical/Trade school, Regular High School Diploma (or German Realschulabschluss) , GED or alternative credential, Some High School (or German Hauptschulabschluss), I prefer not to answer, Other (free text)] [8]

3aEd: Please specify the highest degree or level of school you have completed [Some high school credit, no diploma or equivalent, High school graduate, diploma or the equivalent(for example: GED), Some college credit, no degree, Bachelor‘s degree, Master‘s degree, Doctoral degree] [27] [56]
[Some high school, no diploma., High school diploma or the equivalent (for example: GED)., Some college courses, no degree., Career/technical/vocational education. Bachelor’s/undergraduate degree., Master’s/graduate/professional degree., Doctorate/post-graduate degree., Other: (free text)] [34]

4aEd: Please tell us your highest degree of education. (dropdown)[43][36]

5aEd: Highest completed level of education [41]

6aEd: What is your highest educational degree? [High school, College degree, Graduate degree, I don’t want to answer, No degree] [38]

7aEd: What is your highest level of education? Please select one answer. [Bachelor of Science, Master of Science, Bachelor of Arts, Master of Arts, Ph.D., Other:] [5]

8aEd: Highest level of education achieved (if currently enrolled, highest degree received.): [No schooling completed, Some high school, no diploma, High school graduate, diploma or the equivalent (for example: GED), Some college credit, no degree, Trade/technical/vocational training, Associate degree, Bachelor’s degree, Master’s degree, Professional degree (e.g., J.D., M.D.), Doctorate degree, Prefer Not To Say] [9]

9aEd: What is the highest level of education that you have completed? (a) 12th grade or less (b) High school degree or equivalent (c) Some college, no degree (d) Bachelor’s degree (e) Master’s degree (f) Other graduate degree 11(Main survey)

10aEd: What is your target degree? Please select one answer. [Bachelor of Science, Master of Science, Other: (free text)] [5]

11aEd: In which programme are you currently enrolled? [Bachelor of CS, Master of CS, Other] [33]

12aEd: What is the highest level of school you have completed or the highest degree you have received? [Less than high school degree, High school graduate (high school diploma or equivalent including GED), Some college but no degree, Associate degree in college (2-year),

Bachelor's degree in college (4-year), Master's degree, Doctoral degree, Professional degree (JD, MD), Prefer not to answer] [29]

Job information:

Job title:

1aJ: At which department are you working? (only displayed for participants who are either PhD student, Post Doc or Professor)[16]

2aJ: Please specify your current (or most recent) job title [56]

3aJ: What is your current job role? For example, Network Security Engineer, Penetration Tester) [Researcher, Principal Architect, IT Strategist, CEO, Manager, Security Engineer, Engineer, Other (free text)] [8]

4aJ: What best describes your job at the company? [UI Designer, UX Designer, UX Director, Interaction Designer, Sales Manager, Software Developer, Security Officer, Legal Officer, Hardware Designer, Hardware Engineer, Product Manager, Other:] [2]

5aJ: What is your current job position? What are your responsibilities? [5]

6aJ: (Non-experts only) [8] What is your occupation? (open ended) [43]

7aJ: What is your current occupation? [Freelance developer, Industrial developer, Industrial researcher, Academic researcher, Graduate student, Undergraduate student, Prefer not to answer, Other:] [12][54]

8aJ: What is your current main occupation? [Employee, Freelancer, Researcher, Apprentice, Undergraduate part-time student, Undergraduate full-time student, Graduate part-time student, Graduate full-time student, Other (please specify)] [57]

9aJ: What is your current main occupation? [Freelance developer, Industrial developer, Industrial researcher, Academic researcher, Undergraduate part-time student / Undergraduate full-time student, Graduate part-time student, Graduate full-time student, Other: (free text) [57] [1]

10aJ: What is your current main occupation? [Freelance developer, Industrial developer, Industrial researcher, Academic researcher, Undergraduate student, Graduate student, Other] [61]

11aJ: What is your current occupation? [Student Undergraduate, Student Graduate, Other: (free text) [14][61]

12aJ: Is software development part of your current job? [Yes, No, Other (please specify)] [57]

13aJ: What other roles have you had in the past (select all that apply)? [Internal pentester, External pentester, Internal red teamer, External red teamer, Blue teamer, Quality assurance engineer, Purple teamer, Bug bounty hunter, CISO, Other][7]

14aJ: Do you also have to work on security-relevant tasks in your field of activity? [Yes, No] [57]

Employment status:

1aEm; (Non-experts only) Which describes your current employment status? (multiple-choice) [Employed full-time, Employed part-time, Self-employed, Care-provider, Homemaker, Retired, Student - Undergraduate, Student - Masters, Student - Doctoral, Looking for work / Unemployed, Other (free text)] [8]

2aEm: Please select the response option that best describes your current employment status. [Working for payment or profit, Unemployed, Looking after home/family, A student, Retired, Unable to work due to permanent sickness or disability, Other, Prefer not to answer] [27][42][56]

3aEm: If you are working for payment, please specify your current job title. [42]

4aEm: If you are currently working for payment, please specify the business sector which best describes you job [Technology, Government or government contracting, Healthcare and social assistance, Retail, Construction, Educational services, Finance, Arts/Entertainment/Recreation, Other] [42]

5aEm: Employment Status: Are you currently? [Student, Other: (free text)] [44]

6aEm: Current employment status: [Full time employment for salary / wages, Part time employment for salary / wages, Self-employed, Unemployed, A homemaker, A student, Retired, Unable to work, Prefer Not To Say[[9]

7aEm: Are you employed, self-employed or out of work? If you're a student, please choose what you do besides studying. [I'm employed part-time., I'm employed full-time., I'm my own boss., I do not work at the moment.] [34]

8aEm: Are you currently a student? • Undergraduate • Graduate • Professional certification program • Other [specify] • Not a student 20(Exit survey)

9aEm: Currently, do you have a part-time job in the field of Computer Science? If yes, please specify: (free text) [4]

10aEm: Do you currently have a part-time job in the field of Computer Science? [No, Yes (please specify) [1]

Worked as a certain role:

1aW: For how many years have you worked as a professional system administrator? (free text) [4] [10]

2aW: How long have you been working as admin/developer? [41]

3aW: How long have you been working as a hacker or a tester? [Less than 1 year, 1 to 5 years, 6 to 10 years, More than 10 years] [7]

4aW: Profession/ Recent professional status [41]

5aW: What is your job title (employment status)? [7]

6aW: What is your job title? [11]

7aW: Are you a software developer? If yes, since:... [41]

8aW: Are you a system administrator? If yes, since: .. [41]

9aW: How long have you worked as an operator overall? [Less than 1 year., 1 up to 3 years., More than 3 up to 5 years., More than 5 up to 10 years., More than 10 up to 20 years., More than 20 years.] [34]

10aW: How many years of experience do you have in system administration?[33]

11aW. Do you participate in bug bounty programs? (If yes, how many times have you been awarded a bug bounty? and how many years have you been working as a bug hunter?) [7]

12aW: Have you ever worked as a system administrator? [33]

13aW: What web servers have you set up before? (e.g. * Apache, nginx,...) [33]

14aW: How many web servers have you set up before? [0,1,2-5,6- 15,> 15][33]

15aW: Have you ever worked as a system administrator before? [Yes, No] [31]

16aW: For how many years have you worked as a System administrator before you entered your current role? [11]

17aW: First, we would like to learn more about your experience as a mobile app developer. How many years have you worked in mobile app development? [Less than one year, Between 1 and 2 years, Between 2 and 3 years, Between 3 and 4 years, More than 5 years] [9]

Team:

1aT: Are you working in a team with others, such as developers, testers, project managers? [Yes, No] [24]

2aT: What is your role? (single choice) [Programmer, Tester, Project Manager, Non-Specific] [24]

3aT: What other roles apart from yourself are there in your team? (multiple choice) [Programmer, Tester, Project Manager, Non-Specific] [24]

4aT: About how many people (including developers, project managers, testers) are there in your team? (number) [24]

5aT: How many members are there in your team? (Number) [57]

6aT: Do you work in a team? [Yes, as a team leader, Yes, as a team member, No , Other (please specify):] [4]

7aT: Does your team have a security focus in its current field of activity? [Yes, No, I work alone and my field of activity has a security focus., I work alone and my field of activity has no security Focus.] [57]

8aT: Did you create the code on your own or in a team? [I worked on my own; I worked in a team.] [61][1]

9aT: What is your division's mission or objective? (free text) [29]

10aT: What is your group's mission or objective? (free text) [29]

11aT: What are your responsibilities? (free text) [29]

12aT: Estimated development team size for team that developed this app: [1-4, 10-19, 20-99, 100-499, 500-999, 1,000+][9]

Certifications:

1aC: In your opinion, what type of education or certifications you think helped you most with the type of software security testing you do? [7]

2aC: How have these technical certifications, courses, or degrees helped you complete your current role? [11]

3aC: What technical certifications, courses, or degrees have you completed, if any? You may paste entries from your resume or CV if you wish. [11]

4aC: When did you complete these certifications or education? (multiple choice) [Before I took up my current role, After I took up my current role] [11]

5aC: What kind of job related education did you receive? (e.g. training, certificate, university) (free text) [4]

6aC: Do you have any industry certifications? [Yes, Yes but expired, No] [29]

7aC: Which certifications do you currently possess? (free text) [29]

Company/Organization Demographics:

Company size:

1aCo: How big is the company you work at as a system administrator? [less than 10 employees, up to 50 employees, up to 250 employees, more than 250 employees] [4]

2aCo: How large is your company? [up to 10 employees, 10-50 employees, 50-100 employees, >100 employees] [38]

3aCo: How large is the organization that you work for? [≤10 employees, 11 - 50 employees, 51 - 100 employees, 101 - 500 employees, 501-2000 employees, More than 2000 employees] [11]

4aCo: How big is the company that you are working for? [41]

5aCo: Estimated company size for company that developed this app: [1-4, 10-19, 20-99, 100-499, 500-999, 1,000-4,999, 5,000-9,999, 10,000+][9]

Number of of employees:

1aN: What is the approximate total number of employees your company has? [1 - 3, 4 - 9, 10 - 49, 50 - 999, 1,000 - 4,999, 5,000 or more, I don't know] [34]

2aN: How many employees does your company have? [Less than 25, 26-50, 51-100, 101-250, 251-500, 501-1000, More than 1000] [2]

3aN: How many people work at your company? [7]

4aN: What is the total number of employees in your organization? [1-9, 10-249, 250-499, 500-999, 1000 or more] [57]

Security training:

1aS:. Which of the following statements best describes the security-related training you have received concerning system administration?

- I received security-related training for system administration at that company
- I did not receive security-related training for system administration at that company, but I have received such training at a previous company or school
- I have never received security-related training for system administration] [4]

Other company demographics:

1aOC: Briefly describe your career path (e.g., bug bounty hunter, pen tester and then red teamer) [7]

2aOC: How long have you been working at your company? [No Experience, Less than 1 year, More than 1 year and less than 3 years, More than 3 years and less than 5 years, More than 5 years and less than 7 years, More than 7 years] [2]

3aOC: What kind of business do you work for? Please refer to the core business of the company you work for. [IT Service Provider (such as internet, network, storage, application as a service), IT Enterprise (e.g. sofware company), Non-IT Enterprise (core businesses other than IT), Government/ Public Services. [34]

4aOC: What is your company's main line of business? [7]

5aOC: What is the industry of the organization that you work for? [11]

6aOC: In which field are you currently working in your company? [Consulting, Software development, Testing, Other (please specify)] [57]

7aOC: Which of the following best characterizes your workplace? (multiple-choice) [University, Corporate research lab, Industry, Government, Self-employed, Other (free text)] [8]

8aOC: What best describes your company? [Consultant Company, Product Company, Service Company, Platform Company] [2]

9aOC: Does your organization have an AS number? [Yes, No] [47]

10aOC: Is this company an IT company (software/hardware development, hosting, ISP, ...)? [Yes, No, Other (please specify):] [4]

11aOC: Which of the following statements best describes your role in this company?

- My primary responsibility was system administration
- My primary responsibility was not system administration, but I spent at least 20% of my time on system administration
- My primary responsibility was not system administration, but I spent between 1% and 19% of my time on system administration
- I did not perform system administration at that company [4]

12aOC: In a few words, what would you consider as your main task in the company you are working at? (free text) [4]

13aOC: What is your main task as a system administrator? If it is the same as in the previous answer, please answer: same. (free text) [4]

14aOC: What kind of systems do you administer? [Clients (e.g. workstations), Servers, Mobile Clients (eg. tablet, smartphone), Other (please specify): [4]

15aOC Please describe the type of website you operate and/or the organization/business it represents. Example responses include: personal site, banking website, corporate website - healthcare, government site. [46]

16aOC: What is your company's scope? [41]

17aOC: Approximately how many people are tasked with responding to reported security incidents or security/abuse notifications for this website? [None, 1, 2-5, 5-10, 10-50, >50, Other] [46]

18aOC: Is your job a management position? Do you get to make decisions on budget, equipment, staffing…? [YES., More or less., NO.] [34]

19aOC: Which field of activity does your company belong to? [Game development, Development of network and communication software, Web development, Development of middleware, system components, libraries and frameworks, Development of other tools for developers, such as IDEs and compilers, Other: (free text)][57]

20aOC: Does your company have a security focus? [Yes, No] [57]

21aOC: How old is your organisation? [Please specify in years.] [57]

22aOC: How many years of IT experience do you have in large organizations? (number) [29]

23aOC: How many years of IT experience do you have in small organizations? (number) [29]

Understanding and help:

1aU: Technical Score: I have a good understanding of Computers and the Internet: Likert Scale from 1 (agree) - 7 (disagree) [41]

2aU: I often ask other people for help when I am having problems with my computer: Likert Scale from 1 (agree) - 7 (disagree) [41]

3aU: I am often asked for help when other people have problems with their computer. Likert Scale from 1 (agree) - 7(disagree)[41]

Other:

1aO: Please enter your pseudonym: (free text)[5]

2aO: (Non-experts only) What is your Mechanical Turk Worker ID? (free text) [8]

3aO: Do you remember taking a survey with similar questions in the past (ca. 2014)? [Yes, No] [8]

4aO: (Optional) Is there anything else you'd like to add or clarify? (free text) [8]

5aO: Please indicate whether you would be ok with us con-tacting you regarding future studies even if you are not selected for this study: (a) I agree to be contacted regarding future studies (b) I do not agree to be contacted regarding future studies. [27]

6aO: Please enter your email address so the we can contact you for the interview, if you are selected. [27]

7aO: Your contact information will only be used to invite you to participate in the study. After the study, all records of your contact information will be destroyed unless you indicated above that you agree to be contacted regarding future studies [27]

8aO: Thank you for answering the questions! If you have any comments or suggestions, please leave them here: [free text] [14][33][1][61]

9aO: Please enter your Study ID: [33] / Participant ID (assigned prior to the lab experiments) [31] / Your study-ID [57][1]

10aO: Do you have further comments, thoughts or suggestions? (free text) [54]

11aO: Thank you for taking part in the survey! If you like to receive the study results and/or to participate in future studies then please provide your email address. This data will be stored separately from the survey and will not be published. [54]

12aO: Check any that apply (multiple choice): (1) I would like to receive the study results (2) You may consider me for future studies [54]

13aO: Please enter your email address (free text) [54]

14aO: Please enter your e-mail address, so we can contact you for our study: [33]

15aO: Please enter your name: [33]

16aO: How do you rate the payment of the study? [Way too little / Too little / Just right / Too much / Way too Much] [57][61][1]

17aO: Do you wish to be contacted by our research group to be informed about the study results? [Yes / No] [57][1]

18aO: Would you like to be invited by our research group for further studies in the future? [Yes / No] [57] [1]

19aO: If you wish to be contacted by our research group, please provide us your email address. The email address will be stored separately from the study data. Email address: [Free Text] [57] [1]

20aO: If you wish to be contacted by our research group to be informed about the study results, you can provide us your email address. The email address will be stored separately from the study data. [free text][61]

21aO: If you wish to be contacted by our research group for further studies in the future, you can provide us your email address. The email address will be stored separately from the study data. [free text][61]

22aO: Can you please fill out this questionnaire together with all people who did the coding? [Ok, my team is here; Sorry, I can’t get my team right now, but I was involved in the coding process; Sorry, I can’t get my team right now and I was not involved in the coding process.] [61][1]

23aO: Can you please fill out this questionaire together with all people who did the coding? [Ok, my team is here, Sorry, I can't get my team right now, but I was involved in the coding process, Sorry, I can't get my team right now and I was not involved in the coding process.][11]

24aO: At any point, did you think this task could be part of a scientific study? [Yes, No] – If yes: When did you think this task could be part of a scientific study? [free text] – If yes: Why did you think this task could be part of a scientific study? [free text][61]

25aO: Are you in contact with other freelancers working on freelancer.com? [Yes, No] – If yes: How do you communicate with other freelancers working on freelancer.com? [free text] [61]

26aO: Are you in contact with other freelancers working on freelancer.com? [Yes, No] [1]

27aO: How do you communicate with other freelancers on freelancer.com? [Email, Private chat via freelancer.com, Other (please specify)] [1]

b. Experiences, Skills, and Knowledge:

Security skills/knowledge, Secure development

1bS: How many total years of experience do you have in computer security? ’Experience’ includes years at work or studying in a security-related field. (multiple-choice) [At least 1 but less than 5 years, At least 5 but less than 10 years, At least 10 but less than 15 years, 15 years or more, None] [8]

2bS: On a scale from 1-5, how would you assess your reverse engineering skill level (1 being a beginner and 5 being an expert)? [27][5]

3bS: How many total years of experience do you have with reverse engineering? [27][44]

4bS: How many total years of experience do you have with hardware reverse engineering? [5]

5bS: How many total years of experience do you have with malware analysis? [44]

6bS: Which binary code decompilers did you use before? [Boomerang, Hex-Rays, REC,DISC, Other: (free text)] [44]

7bS: Please select the range that most closely matches the amount of time you typically spend performing reverse engineering tasks per week. [<5 hours, 5-10 hours, 10-20 hours, 20-30 hours, 30-40 hours, 40+hours] [27]

8bS: Please select the range that most closely matches the amount of time you typically spend performing non-reverse engineering, technical tasks per week (e.g. soft-ware or hardware programming, system administration,network analysis, etc). [<5 hours, 5-10 hours, 10-20 hours, 20-30 hours, 30-40 hours, 40+hours] [27]

9bS: Please select the range which closely matches the num-ber of software systems you have reverse engineered?(a) 0-3(b) 4-6(c) 7-10(d) 11-25(e) 26-50(f) 51-100(g) 101-500(h) 500+ 27(screening)

10bS: Security plays an important role in my everyday work. (7-point-Likert, strongly agree - strongly disagree) [41]

11bS: When you are confronted with security-critical decision, do you make them mostly alone or mostly with a team? [41]

12bS: Which security lectures did you pass in your Bachelor/Master programme? (To select)/Other: (free text) [14][61]

13bS: How important is security for sales? [Likert Scale] [24]

14bS: How knowledgeable do you consider yourself about information security? [Likert Scale] [24]

15bS: Do you have information security background? [36]

16bS: Does your app development ever get support from professional security experts? [Yes, No] [24]

17bS: Who are these professional security experts (on team/external)? (single choice) [24]

18bS: What support do you get from them? Please select all that apply (multiple choice) [Penetration testing, Security training, Audits Design reviews, Working on team, I don't know] [24]

19bS: About how often do you get support from them? (single choice) [Continuously, Weekly, Monthly, Quarterly, Yearly] [24]

20bS: Which of the following have led to changes in the security of your app(s) in the past one to two years? (multiple choice) [Decision from management, Security crisis within your organization, Media coverage about app security, Something bad happening to a competitor, Pressure from a partner company, Drive from product or sales team, Pressure from customers, Developer initiative GDPR requirements, Something bad almost happening to your organization] [24]

21bS: What changes have you made as a result of GDPR requirements? (multiple choice) [Addition of popup dialog(s), Removal of analytics or advertising based on it, Adding or changing privacy policy] [24]

22bS: How much do you use each of the following techniques to find security problems? (single choice per technique) [Every build, Every release, Once or occasionally, Decided not to use, Haven't considered it.]

- Producing a threat assessment for the app
- Scanning code with an automatic code review tool
- Using a tool to scan for libraries with known vulnerabilities
- Code review by someone other than the developer
- Penetration testing [24]

23bS: What other techniques do you use (if any)? (free text) [24]

24bS: Do you have a security champion within your team? A security champion -- or security hobbyist -- is a non-expert, who takes a particular interest in security. [Yes, No] [24]

25bS: How did you learn hacking/vulnerability discovery skills? (select all that apply) [Reading blog posts, Following hacker write-ups on bug bounty platforms, Following hacker write-ups on GitHub, I am majored in CS, Cybersecurity professional training, Other] [7]

26bS: Have you received formal security education in computer security or software engineering? if yes, please list the degrees and security certifications you have. [7]

27bS: How many security professionals does your company have? [7]

28bS: Where do you usually look for security related coding questions? (website)[36]

29bS: Check all that apply: Have you ever taken a computer security class? [At an undergraduate level, At a graduate level, Via online learning, Via professional training, Aanother way [specify], No, but I took a class that had security as one major component or module, No] [20]

30bS: How many computer security classes total have you taken? (number) [20]

31bS: When did you last take a computer security class? (year) [20]

32bS: Check all that apply: Do you have experience working in computer security or privacy outside of school? [Professionally (you got paid to do it), As a hobby, No, Other [specify]][20]

33bS: How familiar are you in using the bash-shell? (Likert: “Not familiar at all” to “Very familiar”) [33]

34bS: Have you ever configured a web server? [Yes, No] [33]

35bS: How often do you ask for help when faced with security problems? 1 - Never - 7 - Every time [57][1]

36bS: How often are you asked for help when others are faced with security problems? 1 - Never - 7 - Every time [57][1]

37bS: How often do you need to add security to the software you develop in general (apart from this study)? 1 - Never - 7 - Every time [57][1]

38bS: How often have you stored passwords in a database in the software you have developed (apart from this study)? (free text) [57][1]

39bS: How would you rate your background/knowledge with regard to secure password storage in a database? 1 - Not knowledgeable at all - 7 - Very knowledgeable [57][1]

40bS: Please rate how certain you are that you can do the digital security tasks below by using the sliding bars. Rate your degree of confidence by recording a number from 0 to 100 using the scale given below [(Cannot do at all) 0-50 (Moderately can do) 50-100 (Highly certain can do)]: [Monitor critical assets, Identify Threats, Mitigate Threats, Proactively Respond to Intrusions and Eliminate Threats][29]

41bS: I have a good understanding of security concepts. (Likert scale) [1: Strongly disagree - 7: Strongly agree] [35][14][33]

42bS: How often do you ask for help facing security problems? (Likert scale) [1: Strongly disagree - 7: Strongly agree] [35][14][33]

43bS: How often are you asked for help when somebody is facing security problems? (Likert scale) [1: Strongly disagree - 7: Strongly agree] [35][14][33]

Security mechanisms:

1bSM: How often do you need to integrate security mechanisms in your code? (single choice)

- Frequently - I use security mechanisms in more than 66% of my development tasks
- Occasionally - I use security mechanisms in more than 33% but less than 66% of my development tasks
- Rarely - I use security mechanisms in less than 33% of my development tasks
- Never - I never use security mechanisms in any of my development tasks [54]

2bSM: Who is, in your opinion, responsible for integrating security mechanisms in software systems? (free text) [54]

3bSM: Which security mechanisms did you implement in your code? (free text) [54]

4bSM: What are the most common security-related functions you use in your code? Don't rank functions you never used. Use "Other (1)" to "Other (5)" for missing functions as needed. [API keys, Authorization / Authentication, Encryption / Decryption, Fraud prevention, Input validation, Key management and generation, Secure connections and communications, Signature generation and validation, Store and authenticate user names and passwords, Transfer files securely, Other (free text)] [54]

5bSM: Assume your current task is to integrate a security mechanism in your code (e.g. secure communication, user login or input validation). Please list the first work steps you would do. (multiple free text): [1. step (free text), 2. step (free text), 3. step (free text), 4. step (free text), 5. step (free text)][54]

6bSM: What is, in your opinion, the difference between security-related programming tasks and non-security related tasks? (free text) [54]

7bSM: Did you ever had problems implementing security mechanisms or integrating them into your code? [Yes, No]

If the answer is yes:

- What were those problems? (free text)
- What do you consider as the root cause for these problems? (free text) [54]

8bSM: Which level of abstraction should a security API offer to meet your development needs? (single choice)

- [High - It should be a high level API. I am not interested in implementation details. I just want the security to work.
- Medium - An API should offer me low as well as high levels of implementation details and opportunities, depending on my actual programming task.
- Low - It should be a low level API. I want to determine implementation details myself.
- Other (free text) [54]

9bSM: Is there any API, tool or information resource you would recommend a colleague or friend who struggles with implementing a security mechanism? (free text) [54]

10bSM: What do you think is more appropriate for your needs? Security APIs can be grouped into cryptographic APIs (e.g. encryption algorithms, hash functions and digital signatures) and security controls APIs (e.g. security protocols and mechanisms for authorization or authentication). (Single choice) [Cryptographic APIs, Security controls APIs, Both, None] [54]

11bSM: How often do you need to add security to the software you develop in general (Primed Group: apart from this study)? (Likert scale) [1: Never - 7: Every time] [35][14][1]

12bSM: How often have you added security features to projects you were involved in? (Likert scale) [1: Never - 7: Every time] [33]

Vulnerability research:

1bV: Does your research include the study of computer security vulnerabilities? If no, survey ends. If yes: proceed to the questions below [37]

2bV: Factors that might influence their decision to undertake a particular vulnerability research project: (Likert Scale)

- I have decided not to study a target because it is not a popular product.
- I have decided not to study a target because I lack access to the relevant data.
- I have decided not to study a target because I lack access to the necessary computing infrastructure.
- I have decided not to study a target because of the study's estimated time to completion is too long.
- I have decided not to study a target because of my concerns with legal challenges. [37]

3bV: Have you ever feared legal action (e.g. a cease-and-desist letter, or a civil lawsuit) as a consequence of your vulnerability related research? [37]

4bV: Has this fear of legal action prevented you from engaging in, or prompted you to modify, a research project? [Yes (free text), No][37]

5bV: Have you ever been threatened with legal action (e.g. have you received a cease-and-desist letter from a manufacturer or copyright owner) as a consequence of your vulnerability-related research? [Yes (free text), No][37]

6bV: Have you ever been a named defendant in a court of law (e.g. have you been sued) as a consequence of your vulnerability-related research? [Yes (free text), No][37]

Technical skills:

1bT: On a scale from 1 to 5, how would you assess your proficiency in each of the following technical skills (1 being a beginner or having no experience and 5 being an expert)? [Networking,Database Management, Object-Oriented Programming (e.g., Java, C++), Functional Programming (e.g., OCaml, Haskell), Procedural Programming (e.g., C, Go), Web Development, Mobile Development, Distributed/Parallel Computing, System Administration, Reverse Engineering, Cryptanalysis, Software Testing, Test Automation, Hardware/Firmware Development, Other] [42]

Development experience:

1bD: Are you familiar with Android Studio (or IntelliJ IDE in general)? [36]

2bD: What type(s) of software do you develop? [Web Applications, Mobile Applications, Desktop Applications, Embedded Applications, Enterprise Applications, Other:] [12][54][57][61]

3bD: What type(s) of software do you develop? (multiplce choice) [Web applications, Mobile/App applications, Desktop applications, Embedded Software Engineering, Enterprise applications, Other (please specify)][1]

4bD: How long have you been programming in Python? [Less than 1 year, 1-2 years, 2-5 years, more than five years][43][12]

5bD: For how many years have you been programming in Python? (number) [20]

6bD: How many years of experience do you have with Java development? [< 1 year, 1 - 2 years, 3 - 5 years, 6 - 10 years, 11+ years] [14][61]

7bD: How many years of experience do you have with Java development? (number) [57][61][1]

8bD: How long have you been coding in general? [Less than 1 year, 1-2 years, 2-5 years, more than five years][43]

9bD: How many years of development experience do you have? [Number field 0-100, Prefer not to answer] [12]

10bD: Industry experience [31]

11bD: How many years of development experience do you have? (single choice): [More than 10 years, 5-10 years, 2-5 years, 1-2 years, Less than 1 year, Prefer not to answer [54]

12bD: For how many years have you been programming in general (not just for Android)? (number) [24] [20]

13bD: How many years of experience do you have with software development in general? (number) [57] [61][1]

14bD: How many years of experience do you have in programming? [33]

15bD: How many years of general coding experience do you have? [38]

16bD: How did you learn to code? [all that apply] (self-taught, online class, college, on-the-job training, coding camp) [43]

17bD: Is programming your primary job?
If yes: Is writing Python code (part of) your primary job? [43] [36]
If no: Was programming part of your job in the last 5 years? [36]

18bD: Are you currently employed at a job where programming is a critical part of your job responsibility? [Yes, No] [20]

19bD: How familiar are you with (Java/PostgreSQL/Hibernate/Eclipse IDE)? 1: Not familiar at all - 7: Very familiar [35][57][14][1][61]

20bD: How familiar are you with [Which IDE did you use to solve the task?]? 1: Not familiar at all - 7: Very familiar [35][1]

21bD: How familiar are you with JavaServerFaces/Spring? 1 - Not familiar at all - 7 - Very familiar [57][14][1][61]

22bD: Have you ever written non-browser TLS code? (e.g. for TLS certificate validation?) [41]

23bD: Have you ever configured HTTPS? [41]

24bD: Please select all the ways you use to develop Android app (multiplechoice) [Native Java, JavaScript, C#, Dart, Python, Kotlin, Lua, Native C++] [24]

25bD: What programming language(s) do you use primarily? (multiple choice): (1) C (2) Java (3) Python (4) C++ (5) R (6) C# (7) PHP (8) JavaScript (9) Ruby (10) Go (11) Other (free text) 54(Main survey)

26bD: How often did you release a new version of your app over the past two years? Please give your best estimate; if you have more than one app, please answer for that app that was most frequently updated. (single choice) [Never, Annually, Quarterly, Monthly, More frequently] [24]

27bD: Over the last one to two years, what content has been in your app updates (%)? (percent slider) [New features, Non-security bug fixes, Security bug fixes, Third party library updates, Regular maintenance and refactoring] [24]

28bD: How important is each of the following for your app(s)? Runs on many different devices (Likert scale) [Secure against malicious attackers, Protects users' privacy, Easy to use, Supports many features, Runs smoothly] [24]

29bD: For how many years have you been developing Android apps? (number) [24]

30bD: For how many years have been programming in Android? [36]

31bD: How many years of Android experience do you have? [38]

32bD: About how many Android apps have you helped develop in total? (number) [24][36]

33bD: How many apps have you worked on? [38]

34bD: How many Android applications you have developed? [36]

35bD: Is developing Android apps your primary job? [Yes, No] [24][38]

36bD: Are you developing your apps as a hobby, are you self-employed or do you work for a company? Please check all that apply. [Hobby, Self-employed, Company, Other][38]

37bD: Have you contributed to an open source project in the past year? [Yes, No][24]

38bD: Check all that apply: Have you ever taken a Python programming class? [At an undergraduate level, At a graduate level, Via online learning, Via professional training, Another way (specify), No, but I took a class that had Python as one major component or module, No][20]

39bD: How many total Python classes have you taken? (number)[20]

40bD: When did you last take a Python class (year) [20]

41bD: Do you have experience programming in Python outside of school? [Professionally (you got paid to do it), As a hobby, No, Other (specify)][20]

42bD: How many Python projects have you worked on in the past? (number) [20]

43bD: When did you last work on a Python project? (year) [20]

44bD: How did you primarily learn to program? (single choice) [Self-taught, In a university / as part of a degree, In an online learning program, In a professional certification program, On the job, Other (specify)] [20]

45bD: How did you learn to write Android code? Please check all that apply. [Self-taught, Class in school, Class in university, On the job, Online coding course, Other][38]

46bD: How would you describe the quality and the type of the code you wrote so far? [Few and small programs (e.g., course exercises), Many small programs, Small programs and few (1 or 2) big programs (e.g., thesis and projects), Big programs] [16]

47bD: Have you ever worked as computer programmer? [No, Yes, part-time, Yes, full-time] [16]

48bD: Do you have high or very high experience in any programming language(s)? If yes, please name them: (free text) [16]

49bD: Did you participate in a Software Reverse Engineering or Hacking Lab Course? [Yes, No, Other] [16]

50bD: What is your experience/knowledge in… (Likert scale) [Code obfuscation, Java, The usage of Eclipse for software development, Debugging software, The usage of Eclipse for debugging software] [16]

51bD: What platforms have you developed apps for? (select all that apply): [Android, iOS, Blackberry, Windows Phone, Other (please specify)] [9]

52bD: How did you learn to develop mobile apps? (select all that apply): [Undergraduate major or course (e.g., BA in computer science), Graduate major or course (e.g., masters degree in computer science), Online course (e.g., a MOOC), Self taught, Online tutorials, Workshop, On-the-job training, Other (please specify) [9]

53bD: How many apps have you worked on in the last 3 years? [9]

Development Environment:

1bDE: Please tell us some details about your usual Python software development tool chain. [12]

2bDE: Which console do you use? (free text) [12]

3bDE: Which text editor do you use? (free text) [12]

4bDE: What IDE do you use? (free text) [12]

5bDE: Which IDE did you use to solve the task? [57][61][1]

6bDE: Do you use other tools for software development?(free text) [12]

7bDE: Why did you not implement your suggestions?(free text) [61]

Software development Demographics

1bSD: How many total years of experience do you have with software development? [56]

2bSD: Have you ever identified a security error in yours or someone else's code? [Never, Once, Multiple times][56]

3bSD: Has anyone ever identified a security error in code you have written? [Never, Once, Multiple times][56]

4bSD: Have you ever worked with someone you would consider a secure development expert? [Never, I have worked with one security expert,I have worked with multiple security experts][56]

5bSD: How often do you communicate with security experts? [Yearly, Quarterly, Monthly, Weekly, Daily][56]

6bSD: Have you ever discussed potential security problems with a secure development expert? [Never, Once, A few times, On a regular basis][56]

7bSD: Please select the range that most closely matches the amount of time you typically spend performing software development tasks per week. [< 5 hours, 5-10 hours, 10-20 hours, 20-30 hours, 30-40 hours, > 40 hours][56]

8bSD: Please indicate the response below that most closely matches your software development skill level: [Expert (recognized authority), Advanced (applied theory), Intermediate

(practical application), Novice (limited experience), Fundamental awareness (basic knowledge), Not applicable] [56]

9bSD: Have you ever participated in any training related to software security (e.g., coursework, employer training, online exercises, etc)? [Yes, No, Not sure] [56]

10bSD: Please select from the list of training types below, all the types of prior software security training you have participated in: [Academic coursework, Certification, Security conference, Online exercises, Employer training] [56]

Administration Demographics:

1bA: How many machines/devices do you manage? [Sliding scale between 0 and 1000+] [11]

2bA: What type of machines/devices do you manage? (Check all that apply) [Laptops, Desktops, Servers, Mobile devices, Routers/network appliances such as firewall middleboxes, Embedded devices/ Internet of Things, Other: (free text)] [11]

3bA: What are the operating systems on the machines that you manage? (Check all that apply) [Mac, Windows, Linux, iOS, Android, Blackberry, ChromeOS, None, Other: (free text)][11]

4bA: What is the predominant operating system, if any? [Mac, Windows, Linux, iOS, Android, Blackberry, ChromeOS, Other: (free text)][11]

5bA: What are these machines used for? (Check all that apply) [Education or training, Personal, Research, Servers, Work, Testing, Other: (free text)][11]

6bA: Which of the following applies to the machines you manage? (Check all that apply) [The machines are used internally by the organization you work for, The machines are used externally by customers of the organization you work for, Other: (free text)][11]

7bA: Which of the following best describes your network? [Stub (no customer ASes), Small content provider, Small transit (<10 customers, has provider), Medium transit (<100 customers, has provider), Large content provider, Large transit (>=100 customers, has provider)] [47]

8bA: How many IP addresses does your network include? [256 or less, Between 256 and 64k, 64k-512k, more than 512k, over 20 million] [47]

9bA: Among all software updates you install for operating systems or any other software running on systems, approximately what percentage do you estimate are security updates?
(Slider 0-100) [4]

10bA: Within your job as a system administrator, how much effort does it take you to keep the software on your systems up-to-date? (Likert scale) [1 - Nearly none" to "7 - Nearly all my capacity][4]

11bA: Within your job as a system administrator, how much effort does it take you to keep the software on your systems up-to-date? (Likert scale) [1 - Nearly none" to "7 - Nearly all my capacity][4]

12bA: What is the typical time-span between the release of an update to the installation in a normal update process? (free text) [4]

13bA: Are you solely responsible for updating the machines you manage? [Yes, No, Other (free text)][11]

14bA: How many updates do you run on the machines that you manage per week? (Slider 0-500+) [11]

15bA: What type of updates do you install regularly? (Check all that apply) [Security updates, Non-security related updates, Other: (free text)][11]

16bA: When do you apply security updates? (Check all that apply) [As soon as they are released, After testing, On a regular cadence, After a specific amount of time since its release has elapsed, Applied automatically, Other: (free text)] [11]

17bA: When do you apply non-security related updates? (Check all that apply) [As soon as they are released, After testing, On a regular cadence, After a specific amount of time since its release has elapsed, Applied automatically, Other: (free text)] [11]

18bA: Are you currently in charge of a web server? [Company, Private, Non-profit association, No] [33]

19bA: Are you currently in charge of a web server? [Yes, I'm currently administrating a company web server., Yes, I'm currently administrating a private web server., Yes, I'm currently administrating at a profit/non-profit association., No.] [31]

20bA: Have you ever installed and configured a web server before? [33]

21bA: Approximately how many people are directly responsible for administrating or maintaining the website? [None, 1, 2-5, 5-10, 10-50, >50, Other] [46]

22bA: Job titles aside – Do you operate IT systems? Do you consider yourself an operator or have you worked as an operator before? [YES, I work as an operator., YES, but it's not my main task., NO, but I worked as an operator before., NO. Never. But I like trolling surveys.] [34]

23bA: What kind of IT systems do you operate how often? [Never, Rarely, Occasionally, Often, Very often] [Computer Operating Systems, Storage Systems, Database Systems, Web Server / Mail Systems,Networks / Infrastructure] [34]

24bA: How Would you describe your level of expertise in operating these systems? [No expertise, Very litle expertise, Some expertise, Qite a bit of expertise, Very much expertise] [Computer Operating Systems,Storage Systems, Database Systems, Web Server / Mail Systems, Networks / Infrastructure] [34]

25bA: How much of your work is "operating"? [10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%, More than 100%] [34]

26bA: What kind of tasks do you do besides operating? [34]

c. Scales:

System Usability Scale (SUS):

We asked you to use the assigned library and the following questions refer to the assigned library and its documentation. Please rate your agreement or disagreement with the following statements: (Strongly agree; agree; neutral; disagree; strongly disagree)

- I think that I would like to use this library frequently.
- I found the library unnecessarily complex.
- I thought the library was easy to use.
- I think that I would need the support of a technical person to be able to use this library.
- I found the various functions in this library were well integrated.
- I thought there was too much inconsistency in this library.
- I would imagine that most people would learn to use this library very quickly.
- I found the library very cumbersome to use.
- I felt very confident using the library.
- I needed to learn a lot of things before I could get going with this library. [43] [58]

Alternative:

- I thought it was easy to use
- I thought it was suitable for programming
- I felt very confident using the tool

- I would imagine that most people would learn to use the tool very quickly.
- I needed technical support to use it
- I had to concentrate to use it
- I would like to use the tool frequently [69]

Our usability scale:

1cO: Please rate your agreement to the following questions on a scale from ‘strongly agree’ to ‘strongly disagree.’ (Strongly agree; agree; neutral; disagree; strongly disagree) [43][14][12][61] usability perception (strongly agree; agree; neutral; disagree; strongly disagree; does not apply), [57]

- I had to understand how most of the assigned library works in order to complete the tasks.
- It would be easy and require only small changes to change parameters or configuration later without breaking my code.
- After doing these tasks, I think I have a good understanding of the assigned library overall.
- I only had to read a little of the documentation for the assigned library to understand the concepts that I needed for these tasks.
- The names of classes and methods in the assigned library corresponded well to the functions they provided.
- It was straightforward and easy to implement the given tasks using the assigned library.
- When I accessed the assigned library documentation, it was easy to find useful help.
- In the documentation, I found helpful explanations.
- In the documentation, I found helpful code examples.

2cO: Please rate your agreement to the following questions on a scale from ‘strongly agree’ to ‘strongly disagree.’ (Strongly agree; agree; neutral; disagree; strongly disagree; does not apply) [43][14][12][57][61]

- When I made a mistake, I got a meaningful error message/exception.
- Using the information from the error message/exception, it was easy to fix my mistake.

3cO: Please rate your agreement to the following questions on a scale from strongly disagree’ to ‘strongly agree

- I had to understand how most of the framework JSF works in order to complete the tasks.
- It would be easy and require only small changes to change parameters or configuration later without breaking my code.
- After doing these tasks, I think I have a good understanding of the framework JSF overall.

- I only had to read a little of the documentation for the framework JSF to understand the concepts that I needed for these tasks.
- The names of classes and methods in the assigned library corresponded well to the functions they provided.
- It was straightforward and easy to implement the given tasks using the assigned library.
- When I accessed the assigned library documentation, it was easy to find useful help.
- In the documentation, I found helpful explanations
- In the documentation, I found helpful code examples.
- When I made a mistake, I got a meaningful error message/exception.
- Using the information from the error message/exception, it was easy to fix my mistake. [1]

SSD-SES:

Please rate your level of confidence in completing the software development tasks given below. [I am not confident at all, I am slightly confident, I am somewhat confident, I am moderately confident, I am absolutely confident, I do not understand the question] [56]

- I can perform a threat risk analysis (e.g., likelihood of vulnerability, impact of exploitation, etc.)
- I can identify potential security threats to the system
- I can identify the common attack techniques used by attackers
- I can identify potential attack vectors in the environment the system interacts with (e.g., hardware, libraries, etc.)
- I can identify common vulnerabilities of a programming language
- I can design software to quarantine an attacker if a vulnerability is exploited
- I can mimic potential threats to the system
- I can evaluate security controls on the system's interfaces/interactions with other software systems
- I can evaluate security controls on the system's interfaces/interactions with hardware systems

- I can identify code that handles sensitive data (e.g., Personally Identifiable Information)
- I can correctly implement authentication protocols
- I can correctly implement authorization protocols
- I can communicate security assumptions and requirements to other developers on the team to ensure vulnerabilities are not introduced due to misunderstandings
- I can communicate system details with other developers to ensure a thorough security review of the code
- I can discuss lessons learned from internal and external security incidents to ensure all development team members are aware of potential threats

- I can effectively communicate to company leadership identified security issues and the cost/risk trade-off associated with deciding whether or not to fix the problem
- I can communicate functionality needs to security experts to get recommendations for secure solutions (e.g., secure libraries, languages, design patterns, and platforms)
- I know the appropriate point of contact/response team in my organization to contact if a vulnerability in production code is identified
- I can determine security controls which are necessary to implement in the system
- I can determine security requirements for the system
- I can identify access points into the system (i.e., attack surface) which could be used by an attacker
- I can identify critical operational requirements which must continue to function or recover quickly after an attack
- I can identify usage patterns that should be disallowed by the system's design
- I can identify potential attack vectors associated with the system under development
- I can identify potential vulnerabilities in the operationalization of software (e.g., human errors)
- I can identify security vulnerabilities in others? code (e.g., peer review or third party components)
- I can identify common coding mistakes that create security vulnerabilities
- I can understand security limitations of a programming language
- I can identify potential vulnerabilities as I write code
- I can use automated code analysis tools to identify vulnerabilities
- I can use software fuzzing tools to identify vulnerabilities
- I can review system design to identify areas where potential security risks exist
- I can identify sections of code that are most likely to include security vulnerabilities
- I can understand security issues and concerns associated with reused code (e.g., code samples, shared code)
- I can apply applicable secure coding and testing standards
- I can use provably secure programming languages
- I can identify secure implementations of common libraries
- I can use a secure implementation of a common library that is recommended by a security expert
- I can apply security principles (e.g., least privilege) into the design of the system
- I can utilize protocols that provide confidentiality of user data
- I can utilize protocols that provide integrity of user data
- I can utilize protocols that provide availability in the face of an attack
- I can utilize protocols that provide non-repudiation
- I can leverage enterprise security services to mitigate vulnerabilities (e.g., enterprise PKI)
- I can leverage enterprise security teams for help to fix vulnerable code
- I can leverage external security review (e.g., penetration testing, bug bounties) to find vulnerable code
- I can design software to prevent potential vulnerabilities

- I can rewrite software to remove vulnerabilities
- I can write code to monitor and log system execution for later review
- I can write error handling code to alert for possible malicious behavior
- I can design software so that it fails gracefully in the face of attack
- I can enumerate edge cases of the system's use
- I can assess that security requirements are met (e.g., through security design and code reviews)
- I can demonstrate the effectiveness of implemented security mitigations
- I can document a system's security implications and assumptions so they are readable and actionable by others
- I can communicate with other internal teams to understand how to securely interact with their systems
- I can write understandable security and privacy error messages to draw the required user/operator attention
- I can maintain awareness of hardware and software technologies' security issues and their potential implications

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Please note that some references here are missing as we did not find survey questions in every paper, or did not collect consent from authors to publish questions they generously shared with us. In addition, we did not add the questions which were study specific and thus could not be used in a generalized way.

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