2014 Best Schools for Cybersecurity©

Sponsored by HP Enterprise Security

Independently conducted by Ponemon Institute LLC

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2014 Best Schools for Cybersecurity
Study of Educational Institutions in the United States
February 2014

Part 1. Introduction

The demand for well-educated cyber security professionals is outpacing the supply in both the public and private sectors. According to former Defense Secretary Robert Gates, the Pentagon is "desperately short of people who have capabilities (defensive and offensive cybersecurity war skills) in all the services and we have to address it."[1]

Ponemon Institute's research has also consistently revealed that one of the major barriers to achieving a strong security posture is the dearth of trained and skilled security professionals. To bring attention to this rising crisis in recruiting and retaining highly skilled professionals in IT security, HP commissioned Ponemon Institute to conduct two studies on the issues of cybersecurity education and IT security hiring practices in organizations.[2]

The objective of the *2014 Best Schools for Cybersecurity* study is to determine those institutions that are achieving a high level of excellence and the characteristics that set

Top rated schools at a glance:
University of Texas, San Antonio
Norwich University
Mississippi State University
Syracuse University
Carnegie Mellon University
Purdue University
University of Southern California
University of Pittsburgh
George Mason University
West Chester University of Pennsylvania
U.S. Military Academy, West Point
University of Washington

them apart. We asked learned individuals to identify and rate U.S. colleges and universities they believe are most committed to advancing students' learning and domain expertise in the emerging fields of cybersecurity and information assurances. Participants were told to use five normatively important criteria, which include the following:

- Academic excellence
- Practical relevance
- Experience and expertise of program faculty
- Experience and background of students and alumni
- Professional reputation in the cyber security community

 A large, national sample composed of experienced practitioners with bona fide credentials in IT and information security provided their candid opinions and impressions of more than 400 institutions of higher learning (a.k.a. master list).[3]

A total of 5,003 individuated ratings of institutions ranging from two-year community colleges to doctoral granting programs were captured in this year's study. Practitioners were asked to rate up to five institutions that provide an academic program in cybersecurity. Individual responses were gathered over a 12-week period concluding in November 2013 and resulted in a final sample of

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[1] *Cyber In-Security Strengthening the Federal Cybersecurity Workforce*, conducted by Partnership for Public Service and Booz Allen Hamilton, July 2009.

[2] *Understaffed and at Risk: Today's IT Security Function,* sponsored by HP Enterprise Security and conducted by Ponemon Institute, February 2014.

[3] The majority of educational institutions rated and ranked in this study participate in a program sponsored by the NSA and Department of Homeland Security (DHS) called the National Centers of Academic Excellence in IA Education (CAE). The purposes of this program is to promote higher education and research in information assurances, thus increasing the field of IA practitioners dedicated to protecting the nation's critical information infrastructure.

1,958 respondents who, on average, provided 2.6 discernible school ratings. These ratings were used to construct a meta ranking for schools meeting a minimum threshold. The components of the meta ranking was vetted with a panel of experts.[4]

Characteristics of the top schools

Based on our qualitative review of the best programs in cybersecurity, we have determined the following 10 characteristics that appear to set them apart:

- Interdisciplinary program that cuts across different, but related fields – especially computer science, engineering and management.

- Designated by the NSA and DHS as a center of academic excellence in information assurance education.

- Curriculum addresses both technical and theoretical issues in cybersecurity.

- Both undergraduate and graduate degree programs are offered.

- A diverse student body, offering educational opportunities to women and members of the military.

- Faculty composed of leading practitioners and researchers in the field of cybersecurity and information assurance.

- Hands-on learning environment where students and faculty work together on projects that address real life cybersecurity threats.

- Emphasis on career and professional advancement.

- Courses on management, information security policy and other related topics essential to the effective governance of secure information systems.

- Graduates of programs are placed in private and public sector positions.

Caveats

We believe this research provides an unambiguous indicator of how practitioners in the cybersecurity community perceive specific schools and programs. While perception is never a perfect substitute for reality, in our experience the consistent view of learned practitioners is an important indicator of educational quality and student performance.

We offer a cautionary note about these results. Based on previous opinion-based studies, we have found that perceptions about specific organizations can be influenced by a number of extraneous factors. In short, individual ratings may not reflect the exceptional features and practices of the institution included in our master list of schools.

Further, what a school does in the area of cybersecurity or information assurance, especially extracurricular activities, may not be known or fully visible to the rater. In addition practitioner ratings may be influenced by positive or negative experience with a particular college or university. Finally, practitioner perceptions may be influenced by external communications and marketing efforts including media coverage, unrelated to the quality and performance of the specific program.

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[4] An elite panel of senior-level practitioners, mostly involving chief information security officers (CISOs), were involved in setting the criteria and methods used for meta ranking.

Part 2. Methods

Using a survey instrument, respondents were ask to name up to five U.S. educational institutions they believe are most committed to advancing students' learning and domain expertise in the emerging fields of cybersecurity and information assurances. To facilitate the selection, the name of 403 schools were provided in a pull down list with the option of sorting by school name (alpha) or U.S. state. The survey instrument also allowed each participant to freely name an institution not contained in the master list.[5]

Table 1 summarizes the survey response. A total of 49,950 IT or IT security practitioners from a wide array of organizations were invited through multiple channels to participate in this study.[6] The survey was fielded over a 12-week period concluding in November 2014. This effort resulted in a final sample of 1,958 reliable surveys, which produced 5,003 separate school ratings – or an average of 2.6 rating per respondent.[7]

Table 1. Sample response	Freq	Pct%
Total sampling frame	49,950	100.0%
Total survey returns	2,219	4.4%
Rejected surveys	261	0.5%
Final sample	1,958	3.9%
Number of school ratings	5,003	
Ratings per respondent	2.6	

Figure 1 summarizes the approximate position level of respondents in our survey research. As can be seen, 65 percent of respondents self report being at or above the supervisory level. The mean years of relevant work experience is 9.85 years (median at 10.0 years). Approximately 76 percent of respondents are male and 24 percent female.

Figure 1: Respondents' position level
Sample size = 1,958

- Executive/VP
- Director
- Manager
- Supervisor
- Technician/Staff
- Consultant

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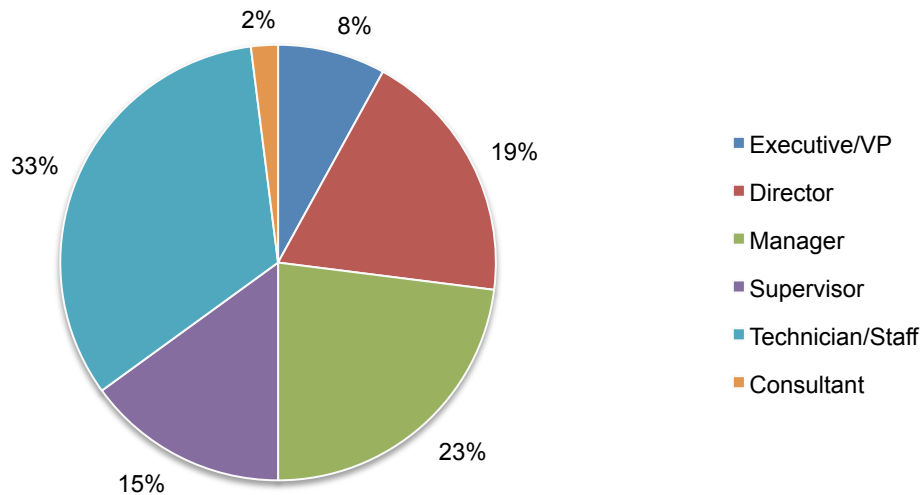
[5]Third-seven respondents added a school name in the free-form survey field, but none of these entries met our minimum threshold requirement for inclusion in the meta ranking.
[6]The sampling frame was created through random selection of Ponemon Institute's U.S. sampling frame.
[7]A subset of 183 educational institutions met the criteria for inclusion in the meta ranking.

Figure 2 reports the primary industry classification of respondents' companies. The largest sectors in our sample include financial services, public sector organizations, health and pharmaceutical companies (including biotech) and retailers (including e-commerce).

Figure 2: Industry sector of respondents' companies
Sample size = 1,958

Legend:
- Financial services
- Public sector
- Health & pharma
- Retail
- Services
- Technology & software
- Industrial
- Consumer products
- Energy & utilities
- Transportation
- Communications
- Hospitality
- Entertainment & media
- Defense & aerospace
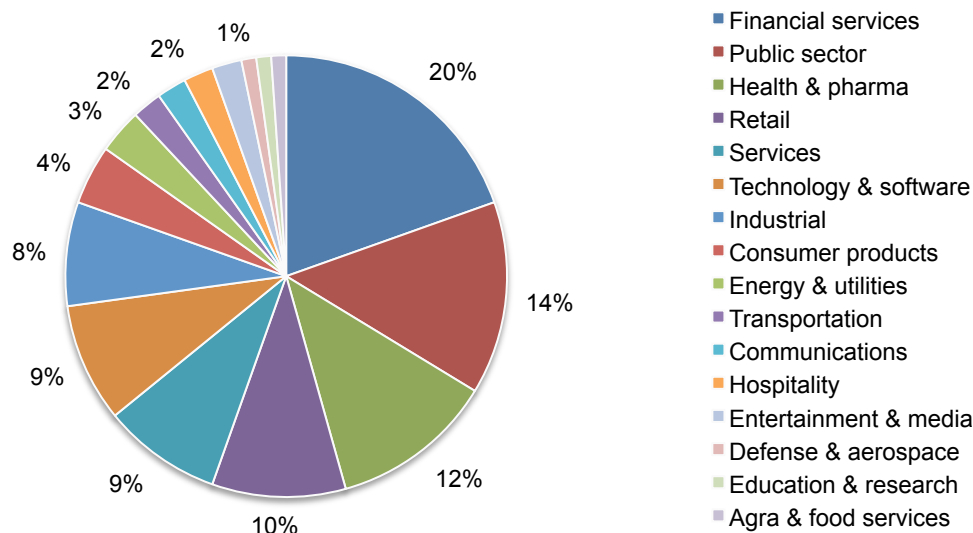- Education & research
- Agra & food services

Figure 3 reports the headcount range of respondents' companies. In this study, headcount serves as a surrogate for organizational size. The largest segment pertains to organizations with a headcount of 1,001 to 5,000. The smallest segment pertains to organizations with more than 75,000 employees.

Figure 3: Headcount (size) of respondents' companies
Sample size = 1,958

Legend:
- Less than 1,000
- 1,001 to 5,000
- 5,001 to 25,000
- 25,001 to 75,000
- More than 75,000
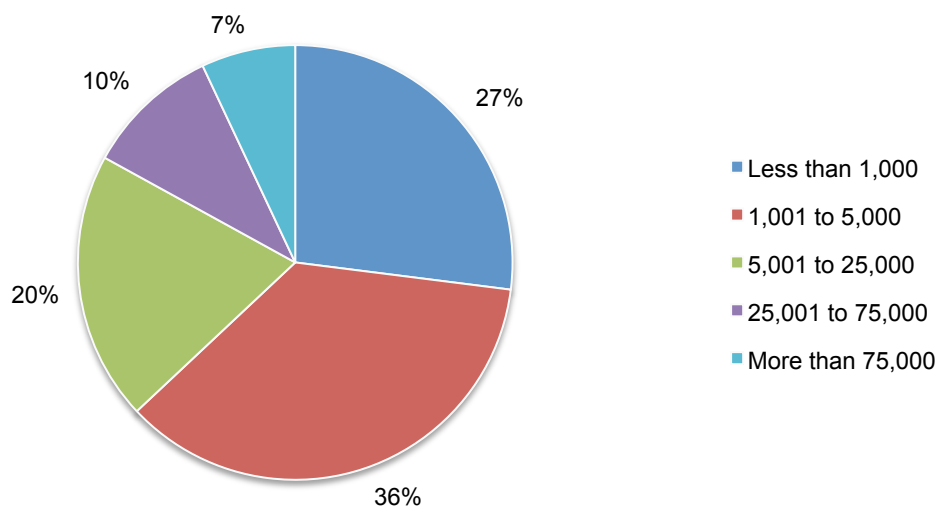
Survey questions

As mentioned, the basic survey design allowed respondents to select up to five institutions for purposes of program rating. For each school selected, respondents were required to complete five questions using a 10-point scale. Following are the exact questions included in the survey:

Q1. For [name of school], please rate this program based on your perception of academic excellence and rigor.

Low	1	2	3	4	5	6	7	8	9	10	High

Q2. For [name of school], please rate this program based on your perception of practical relevance.

Low	1	2	3	4	5	6	7	8	9	10	High

Q3. For [name of school], please rate this program based on your perception of the experience and expertise of program faculty.

Low	1	2	3	4	5	6	7	8	9	10	High

Q4. For [name of school], please rate this program based on your perception of the relevant experience and background of students and graduates.

Low	1	2	3	4	5	6	7	8	9	10	High

Q5. For [name of school], please rate this program based on your perception of the overall professional reputation in the cybersecurity community.

Low	1	2	3	4	5	6	7	8	9	10	High

Each question is equally weighted. Hence, the average of all five questions is used to compile R3 as defined below.

Ranking procedures

We carefully executed the following decision rules to compile a meta ranking of cybersecurity and information assurance programs in the U.S.

First, only educational Institutions with five or more separate ratings were included in the initial ranking procedures mentioned below. A combined rating system composed of three ranking procedures was used to determine the meta rank of a given institution. Following are the three different rating procedures and associated weighting:[8]

R1: The rank order of a given institution based on the total number of ratings. R1 is assigned 10 percent weighting.

R2: The rank order of a given institution based on the percentage that this school was identified first. R2 is assigned 10 percent weighting

R3: The rank order of the average overall rating from five survey questions. R3 is assigned 80 percent weighting.

The **Meta Rank** is simply a weighted average defined as: [(R1*10%)+(R2*10%)+(R3*80%)]/3 for each educational institution that met the minimum threshold.

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[8]The weightings for R1, R2 and R3 were determined by unanimous agreement of the expert panel.

Part 3. Results

Figure 4 shows the top 12 educational programs in ascending order based on the meta ranking procedure, which is a combination of three rank scores as defined above. The lowest meta rank is 2 and the highest meta rank for all rated institutions is 175. The number next to each bar reflects the meta rank for each institution. Like a golf score, a low meta rank is the objective. As can be seen, the University of Texas at San Antonio achieves the top position in this year's study, followed by Norwich University and Mississippi State University. Syracuse University and Carnegie Mellon University are tied in forth place.

Figure 4: The top rated cybersecurity programs
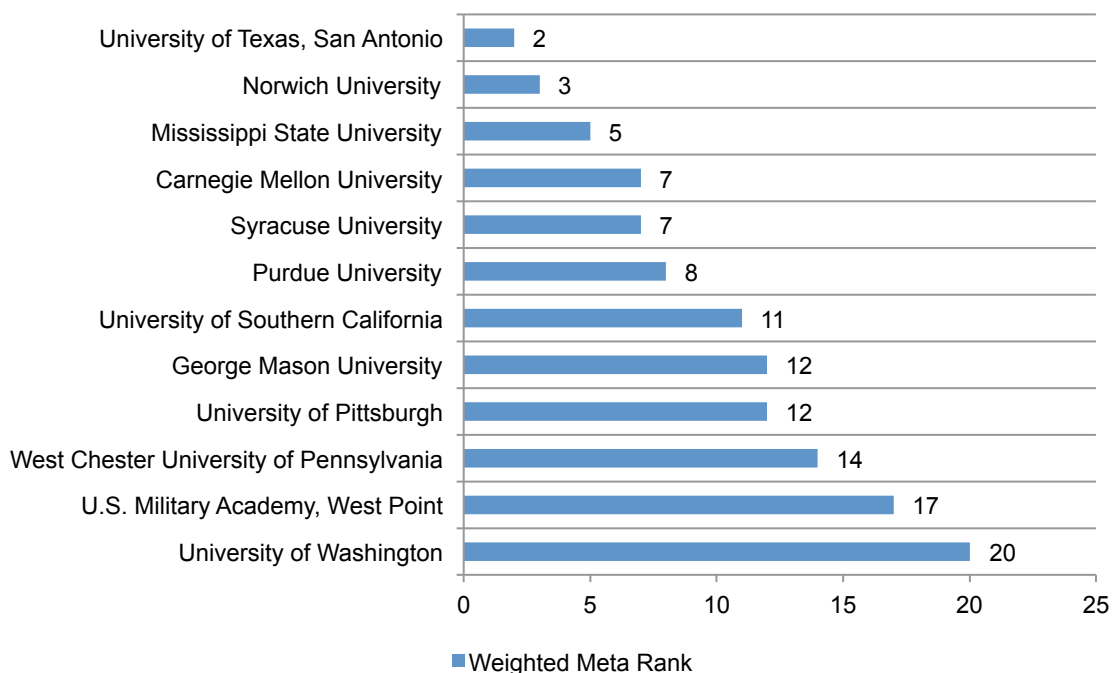Compiled from 183 rated institutions

Table 2 summarizes the data used to construct the R1, R2, R3 and meta rank for the top 12 rated schools. As can be seen, USC received the most individuated ratings. UT San Antonio received the highest number of first choice ratings as well as the highest combined average survey score.

| Table 2. Data used for meta ranking for top rated educational institutions	Number of ratings	Number of first choice ratings	Average survey score
University of Texas, San Antonio	98	90	9.40
Norwich University	69	63	9.20
Mississippi State University	78	67	9.00
Syracuse University	78	70	8.80
Carnegie Mellon University	80	69	8.80
Purdue University	63	44	9.00
University of Southern California	116	57	8.80
University of Pittsburgh	71	66	8.60
George Mason University	91	75	8.60
West Chester University of Pennsylvania	57	45	8.60
U.S. Military Academy, West Point	21	13	9.00
University of Washington	81	40	8.40

Table 3 summarizes key statistics for 183 schools rated by respondents. The mean values are above the medians for three characteristics, suggesting these distributions are slightly skewed.

Table 3. Key statistics for 183 rated educational institutions	Number of ratings	% of first choice ratings	Average survey score
Quartile 1	57.1	75%	8.3
Quartile 2	30.2	39%	7.0
Quartile 3	15.5	17%	6.0
Quartile 4	6.1	01%	4.7
Average	27.3	33%	6.5
Median	23.0	29%	6.4
Maximum	116.0	100%	9.4
Minimum	5.0	0%	3.2

Figure 5 shows the average score for five perception-based questions completed by respondents using a 10-point scale with a scale median of 5.50 (dotted green line). The average scores for all 183 rated institutions range from a low of 5.54 for the question relating to reputation and a high of 7.22 for academic rigor.

Figure 5: Average scores for five survey questions
Compiled from 183 rated institutions
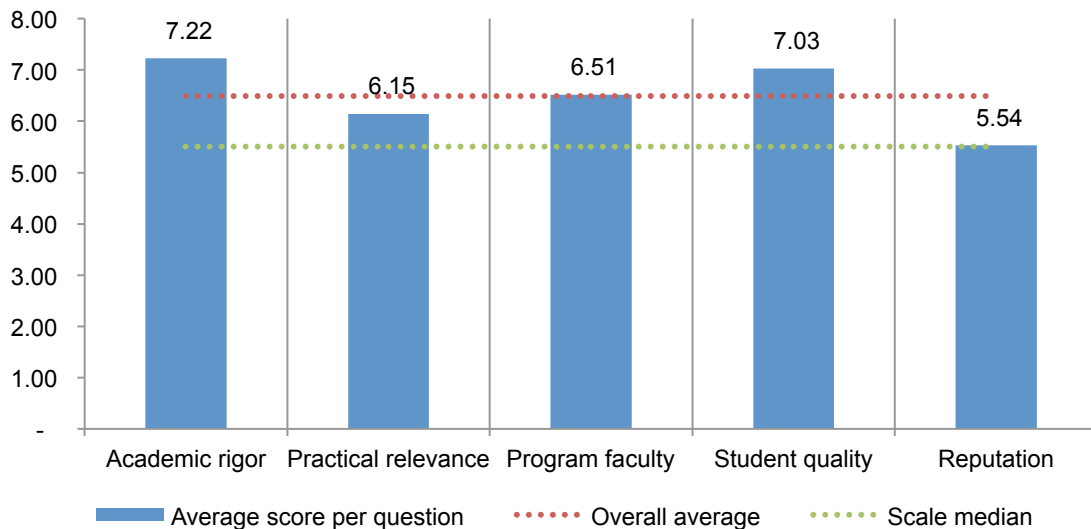
The approximate departmental location of 183 cybersecurity programs is summarized in Figure 6. As shown, the cybersecurity program is most likely to be situated in engineering or computer science. Interdisciplinary studies represent programs that are co-located or shared across academic departments – for example, engineering and computer science or business and library science.

Figure 6: Academic department where cybersecurity is most likely situated
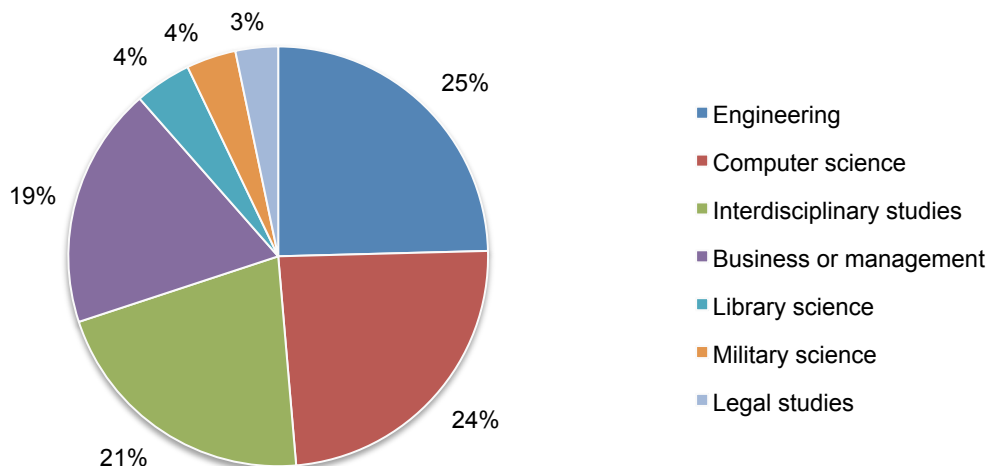Compiled from 183 rated institutions

Figure 7 summarizes the average meta rank of cybersecurity program based on departmental location. Clearly, program location makes a difference. Cybersecurity programs that are interdisciplinary achieve the most positive rating (lowest meta rank), followed by computer science and engineering.

Figure 7: Average meta rank by academic department
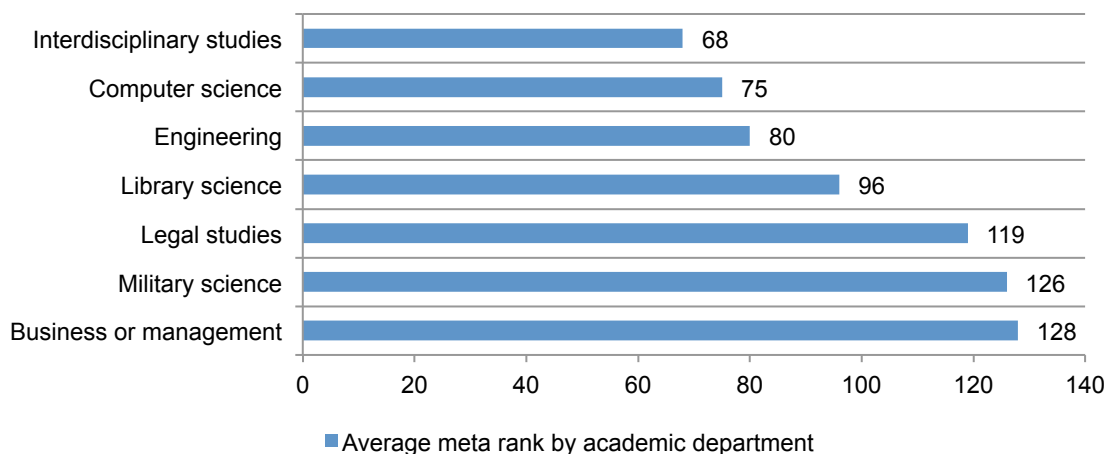Compiled from 183 rated institutions

Figure 8 summarizes the highest degree offered by the 183 cybersecurity programs rated in this research. The largest segment pertains to masters followed by a doctoral degree. A fairly large segment pertains to non-degree programs. Many of these non-degree programs offer course work or a certificate of completion.

Figure 8: Highest degree offered by the cybersecurity program
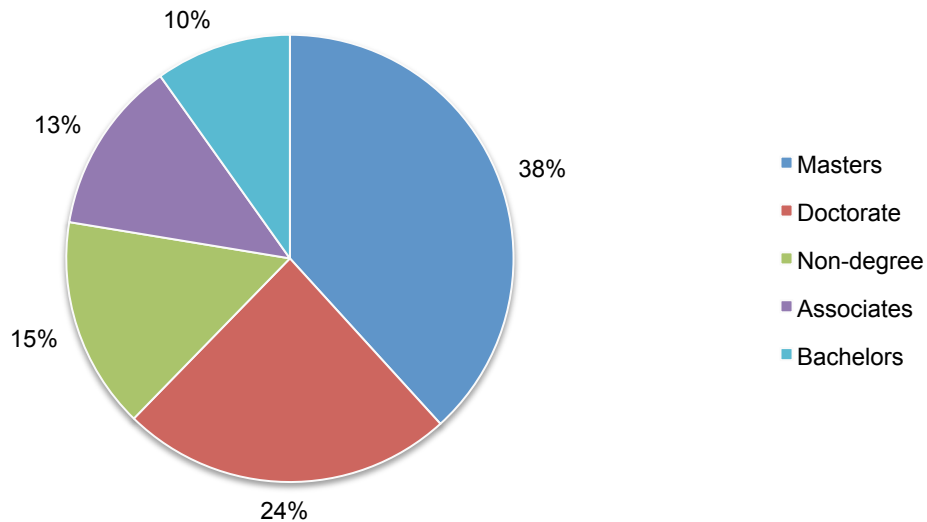Compiled from 183 rated institutions

Figure 9 reports the average meta rank of cybersecurity program based on the highest degree offered. As can be seen, doctoral granting institutions achieve the most positive rating (lowest meta rank), followed by bachelors and masters level programs.

Figure 9: Average meta rank by highest degree offered
Complied from 183 rated institutions
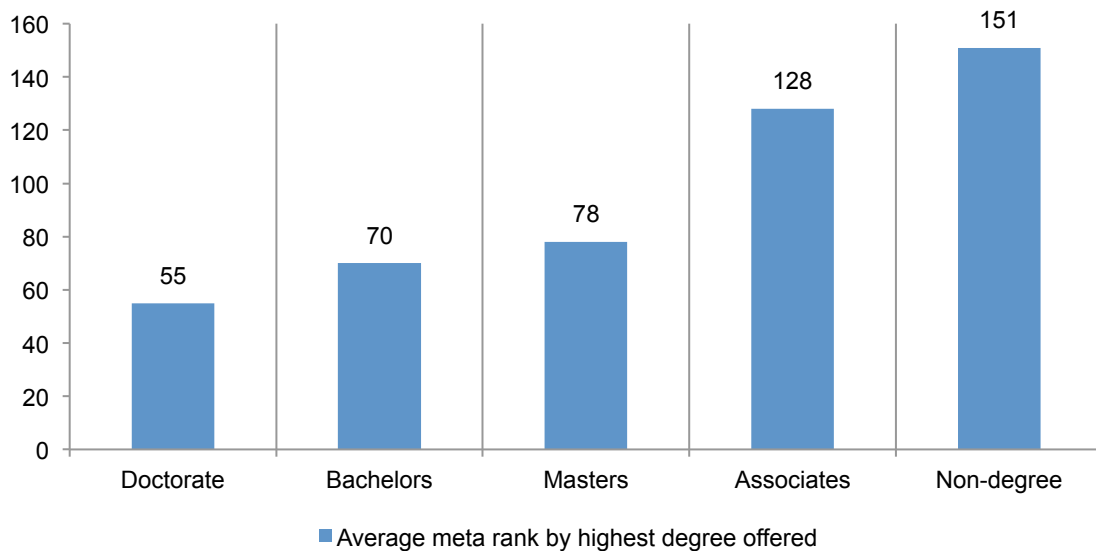
Part 4. Summarized descriptions of top rated cybersecurity programs

Following are the program descriptions for the top rated programs in cybersecurity. Please note that this information was obtained directly from the various program websites and not validated by the researcher.

No.1 University of Texas, San Antonio: The Department of Information Systems and Technology Management offers more than 14 undergraduate and graduate courses in the areas of digital forensics, secure network design, intrusion detection and incident response. Students learn how to protect data, gather and examine digital evidence, perform security risk assessments and study computer and network forensics procedures. Students selecting this degree field will develop special expertise in the information security arena. They will learn how to protect and defend information systems by ensuring their integrity, authentication and confidentiality.

No.2 Norwich University: Norwich's Computer Science and Information Assurance (CSIA) program offers a concentration in Advanced Information Assurance and Digital Forensics. The National Security Agency has designated Norwich University one of the Centers of Academic Excellence in Information Assurance Education, an honor of great value in the security profession.

No.3 Mississippi State University: The Mississippi State University Center for Computer Security Research (CCSR) is dedicated to the scientific exploration of computer vulnerabilities with the objective of improving prevention and detection techniques through our core research areas. We promote computer security education and research.

No.4 (tied) Syracuse University: Information Security Management (ISM) can be defined as the comprehensive skills that manage a high degree of complex technical security, increased operational costs, diverse policies, and user behavior. The Certificate of Advanced Study (CAS) in Information Security Management (ISM) offers a comprehensive set of skills. The 15-credit program provides students with the flexibility to take coursework that does not overlap with their current expertise, while giving them tools in information security technology, policy, risk management, and evaluation, depending on their background. This certificate is offered in both campus and distance learning formats, and can be completed as a full-time or part-time student. The certificate is available to those with or without previous experience in the information technology field. Applicants may be currently working in a related field, or they may be interested in making a career change into the information security field. The certificate also provides an opportunity for professional development in information security and serves as a foundation for career advancement.

No.4 (tied) Carnegie Mellon University: Designated by the National Security Agency (NSA) as a Center of Academic Excellence in Information Assurance (IA) Education, Cylab is directed by Dena Haritos Tsamitis, director of the College of Engineering's Information Networking Institute (INI). Through the INI, as well as the Heinz College, a number of professional graduate degree programs are offered in information networking, information security and information technology, to create a pool of IA professionals who can address the wide range of technology, policy, and management issues in government, industry, and academia. Additionally, several colleges and departments at Carnegie Mellon offer Ph.D. programs. These include the School of Computer Science and the Departments of Electrical and Computer Engineering and Engineering and Public Policy, both from the College of Engineering. The Master of Science in Information Security Technology and Management (MSISTM) provides an in-depth education in topics such as network and distributed system security, secure software engineering, operating system security, and applied cryptography. This focus is complemented with courses in management, information security policy, and other topics essential to the effective management of secure information systems.

No.5 Purdue University: Currently offers an interdisciplinary Master's major in InfoSec. The program is multidisciplinary and requires (and recommends) courses in Computer Sciences as well as other fields. The new Ph. D. Program is an extension of the existing Interdisciplinary Masters' Program in Information Security. It was both the needs and interests of the graduates and the United States Government's (USG) new incentives for preparing Ph.D.-level researchers in the field that have made this development timely and necessary. The new Interdisciplinary major prepares students who are interested in enriching their technical and scientific background in information security and combining it with preparation in a number of other disciplines. The Interdisciplinary Ph.D. Program is currently sponsored by the Departments of Communication and Philosophy, the College of Technology, and the Program in Linguistics, each of which has established a major in Information Security at the Masters' level and has now extended it to the Ph.D. level. Other graduate programs are considering sponsorship at this time. The interdisciplinary Information Security Masters and Ph.D. majors are the first programs in this field in the State of Indiana and the region, and are the first truly multidisciplinary residential programs in the nation.

No.6 University of Southern California: A Comprehensive Approach to Improving Computer Security USC's Center for Computer Systems Security (CCSS) conducts research and provides education in the crucial disciplines of computer, network and application security. Courses are offered at both undergraduate and graduate levels, and are taught through the USC Viterbi School of Engineering Computer Science and USC Ming Hsieh Department of Electrical Engineering and the Information Technology Program. Faculty include distinguished academicians, USC Information Sciences Institute research faculty, and professional cyber-security experts. The CCSS also works closely with DETER, a general-purpose, experimental testbed that supports research and development of next-generation cyber security technologies. DETER enables users to conduct repeatable, medium-scale Internet emulation experiments in malicious code and a wide range of other network security issues. Also located at the Information Sciences Institute, DETER is accessible to CCSS researchers, students and the computer security community.

No.7 (tied) University of Pittsburgh: The Laboratory for Education and Research on Security Assured Information Systems (LERSAIS) provides a framework for long-term goals of (1) establishing a premier research program that focuses on the diverse problems related to security and survivable information systems, networks, and infrastructures, and (2) developing and supporting high quality education in security and information assurance. The University of Pittsburgh has been designated as a National Center of Academic Excellence in Information Assurance Education since 2003 and is one of only 13 Centers in the United States with five CNSS certifications by the National Security Agency (NSA) and the Department of Homeland Security (DHS). It will serve as a multidisciplinary forum for the synergistic interaction among researchers within SIS as well as other experts in IA-related areas outside the school. We invite industry and academic collaborations in all areas of security research.

No.7 (tied) George Mason University: The Center for Secure Information Systems (CSIS) provides a dedicated environment to encourage the development of expertise in both the theoretical and applied aspects of information systems security. CSIS emphasis on information security makes it unique among the institutions of higher learning in this country. Established in 1990, CSIS has the distinction of being the first academic center in security at a U.S. university. It is one of the National Security Agency's original Centers of Academic Excellence in Information Assurance Education, a designation it continues to hold. In 2008, NSA established a new designation – The National Centers of Academic Excellence in Information Assurance Research (CAE-Research). CSIS has earned this new designation, and is designated for both CAEIAE and CAE-Research through 2013. CSIS differentiates itself from other centers by working in a broad spectrum of security topics and issues. The Center resides within The Volgenau School of Information Technology and Engineering (IT&E) at George Mason University (Mason).

No.8 West Chester University of Pennsylvania: The Computer Science Information Security Center (ISC) has introduced Information Security content such as computer and network security in the undergraduate and graduate curricula. The NSA has certified the curricula set forth by the ISC to meet the National Training Standards for Information Systems Security Professionals (4011) and Systems Administrators (4013). Additionally, the Computer Science Department offers specific courses that address technical and theoretical issues in Computer Security. Both undergraduate and graduate students can obtain a Computer Security Certificate by taking course sequences, which emphasize principles of computer security.

No.9 United States Military Academy, West Point: The Academy is dedicated to researching and teaching information assurance, computer, and network security. The center for cyber security research, innovation and education, is responsible for teaching and developing a variety of courses. Included in these courses are Information Assurance, Information Warfare and Forensics.

No.10 University of Washington: The Center for Information Assurance and Cybersecurity (CIAC) prepares students for a career protecting computer systems from accidents, hackers, viruses and other security threats. It is a unique collaboration between information science, computer science, economics, electrical engineering and law. Students have the opportunity to work with nationally known researchers in the field and conduct their own research projects. Research is conducted across multiple departments at the University of Washington and with partnering institutions to create an interdisciplinary knowledge-network.

Appendix 1. Cybersecurity programs in the top quartile

The following list of colleges and universities represent the top 25 percent of all 183 rated by respondents in this research.

Educational Institutions	State	Weighted Meta Rank
University of Texas, San Antonio	TX	2
Norwich University	VT	3
Mississippi State University	MS	5
Syracuse University	NY	7
Carnegie Mellon University	PA	7
Purdue University	IN	8
University of Southern California	CA	11
University of Pittsburgh	PA	12
George Mason University	VA	12
West Chester University of Pennsylvania	PA	14
U.S. Military Academy, West Point	NY	17
University of Washington	WA	20
The George Washington University	DC	21
United States Air Force Academy	CO	22
Air Force Institute of Technology	OH	22
Georgia Institute of Technology	GA	24
United States Naval Academy	MD	24
University of Maryland, College Park	MD	25
Dartmouth College	NH	26
Virginia Polytechnic Institute	VA	26
Naval Postgraduate School	CA	27
Oklahoma State University	OK	28
Rice University	TX	29
University of Missouri – Columbia	MO	29
University of Massachusetts, Amherst	MA	30
University of Minnesota	MN	31
Iowa State University	IW	32
Ferris State University	MI	31
Johns Hopkins University	MD	35
University of Illinois at Urbana-Champaign	IL	36
Boston University	MA	37
Indiana University	IN	38
James Madison University	VA	39
Tuskegee University	AL	38
Howard University	DC	39
Indiana University of Pennsylvania	PA	40
Walsh College	MI	41
Brandeis University	MA	42
Texas A&M University	TX	42
University of Houston	TX	44

Educational Institutions – continued	State	Weighted Meta Rank
University of Kansas	KS	44
University of Tulsa	OK	45
Rochester Institute of Technology	NY	48
University of California at Davis	CA	49
Rutgers, University	NJ	50
Worcester Polytechnic Institute	MA	52

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