

Cisco Networking Academy IoT Fundamentals

Curriculum Overview



9 October 2017

Agenda

- 1 Emerging Technologies and NetAcad
- 2 IoT Fundamentals Learning Pathways
- 3 Getting Ready for IoT Fundamentals
- 4 IoT Fundamentals Details
- 5 IoT Fundamentals Learning Tools

Emerging Technologies and the Networking Academy

Perfect Storm

Massive Youth
Unemployment

74M

Unemployed Youth

McKinsey Center for Government,
Education to Employment

Growing
Skills Shortage

63%

of CEOs see lack of skills
as a serious concern

PWC, 17th Annual
Global CEO Survey

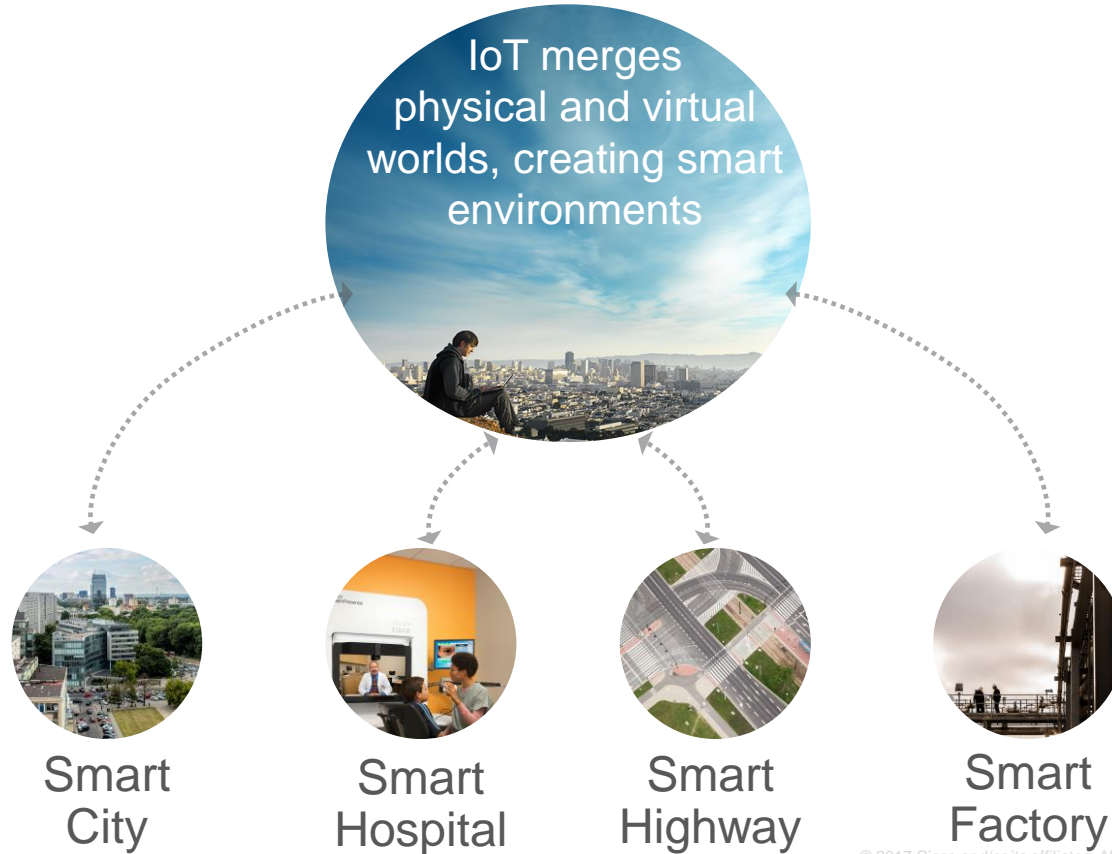
Unprecedented
Opportunity

\$11.1T

Economic Value
Add by 2025

McKinsey Global Institute; IoT: Mapping
the Value Beyond the Hype

Digital Transformation across Countries and Companies



New Opportunities = Employment Paths for Students

Existing Networking Academies



Information Technology



1M Students
20K Instructors
9K Academies



New Academies and/or New Departments at Existing Academies

Process Control Engineering



Energy Management



Industrial Automation

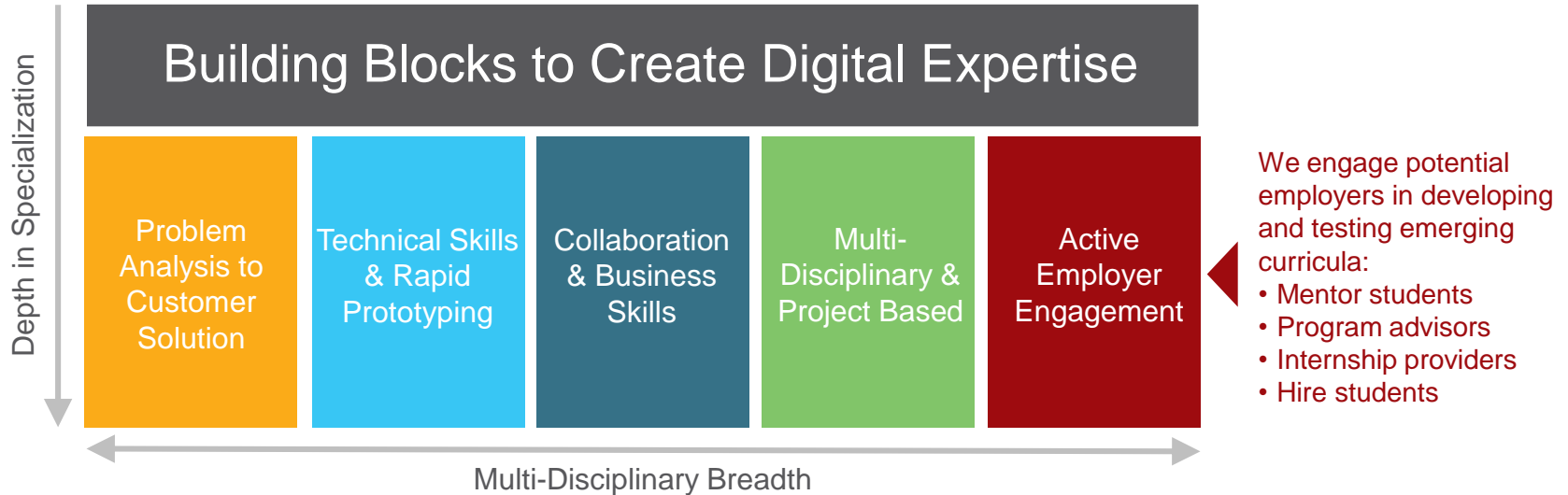


Transportation Engineering

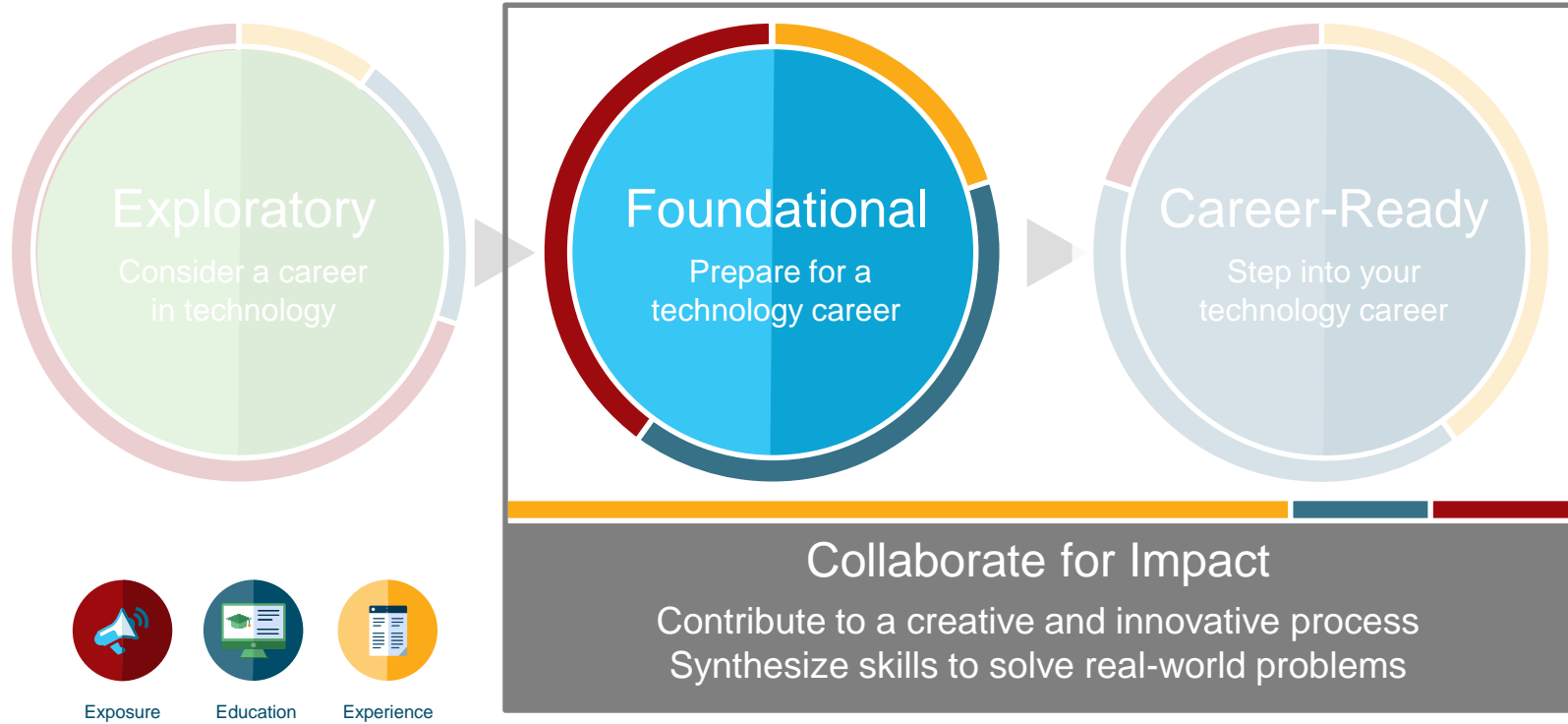
Why Cisco?



Cisco Conducts Research on the new Emerging Technologies Skillsets and How to Teach Them



Emerging Technologies Align with our Portfolio Strategy



The Networking Academy Learning Portfolio

Current & Planned



Aligns to Certification



Instructor Training required



Self-paced

* Available within 12 months

Collaborate for Impact



Introduction to Packet Tracer

Packet Tracer

Hackathons

Prototyping Lab

NetRiders

Internships

Exploratory

Foundational

Career-Ready



Networking



Networking Essentials



Mobility Fundamentals



CCNA R&S: Introduction to Networks, R&S Essentials, Scaling Networks, Connecting Networks



CCNP R&S: Switch, Route, TShoot
ETW: Network Programmability with Cisco APIC-EM*



Security



Introduction to Cybersecurity



Cybersecurity Essentials
IoT Security*



CCNA Security



CCNA Cyber Ops*



IoT



Introduction to IoT



IoT Fundamentals:
Connecting Things, Big Data & Analytics
Hackathon Playbook



OS & IT



NDG Linux Unhatched



NDG Linux Essentials
IT Essentials



NDG Linux I



NDG Linux II



Programming



CLA: Programming Essentials in C



CPA: Programming Essentials in C++

PCA: Programming Essentials in Python*

ETW: REST APIs with Cisco Spark*



CLP: Advanced Programming in C*



CPP: Advanced Programming in C++*



Business



Be Your Own Boss



Entrepreneurship



Digital Literacy



Get Connected

IoT Fundamentals Curriculum

Overview

IoT Fundamentals is a multi-disciplinary hands-on curriculum teaching **how to ideate, prototype and articulate the business value of an “end-to-end IoT Solution”**. The curriculum provides a strong skills and design-thinking foundation for IoT job families that exist today and in the future.

Career Prep

The skills developed in the curriculum is the starting point to prepare for **employer-validated** entry-level job families like:

- IoT Device Management
- IoT Product Manager
- IoT Data Analytics

Learning Components

- Connecting Things course
- Big Data & Analytics course
- Hackathon Playbook
- Cisco Prototyping Lab
- Cisco Packet Tracer

Features



Develop entrepreneurial and social impact mindset through highly engaging hands-on and simulated learning activities including Prototyping Lab and Packet Tracer to develop:

- 21st Century Skills such as Creativity, Critical thinking, Collaboration and Communication
- Rapid prototyping with Sensors, Electronics and Arduino
- Use visual programming or Python to program a Raspberry Pi
- Connect with Cloud Services using RESTful APIs
- Collect, store and visualize data from sensors in real time
- Apply analytics to gain insights from data
- Present IoT solutions and their business value

IoT Fundamentals Visual Summary

Connecting Things



Big Data & Analytics



Hackathon Playbook



Build an End-to-End IoT Prototype



Produce data



Analyze and tell the story from the data



Ideate, design, prototype & present an IoT solution

A New Hands-On Experience

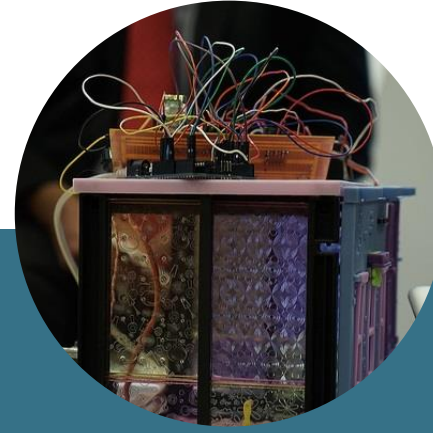
IoT Fundamentals | Lab Experiences



Analyze the Problem
with User Focus



Hands-on Design and
Maker Ethos



Rapid Prototyping, Iterating,
Presenting

IoT Fundamentals Approach

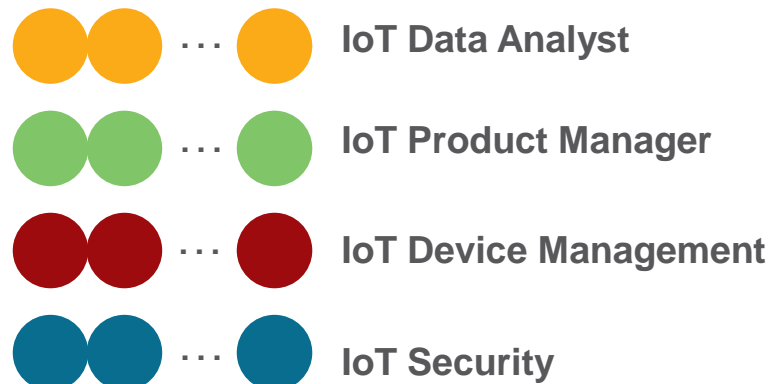
A Interdisciplinary Digital Foundation

...For Many IoT Career-Ready Pathways

IoT Fundamentals



Electronics
Programming
Networking
Data Analytics
Cybersecurity
Problem solving
Design thinking
Soft skills



and many others

IoT Fundamentals Value Proposition

Student

- Recognize and understand the concepts and challenges of the **transformational IoT economy**
- Gain hands-on experience with IoT technology and **rapid prototyping**
- Gain “**IoT generalists**” knowledge in a few verticals: Manufacturing, Energy, Healthcare, etc.
- Leverage networking expertise to **broaden knowledge base** with IoT technology
- Consider learning path to **become an “IoT specialist”**
- **Enhance employability** in both IT and non-IT fields

Instructor

- A **comprehensive, hands-on curriculum** in a fast-changing emerging technology domain.
- **Broaden expertise** to include both networking and IoT technology
- **Strengthen multi-disciplinary experiences** in learning and teaching at your institution
- Align with institution’s desire to be a **world-class organization**
- Support students’ efforts to increase their **employability**

Academy

- Strengthen institution’s reputation as a **leader in teaching emerging and cutting-edge technology**
- Strengthen relationship with national and local **employers**
- Strengthen ability to **recruit students**
- Enhance **students’ employability**

Curriculum Differentiators

Unique competitive feature combination!

Interdisciplinary Approach

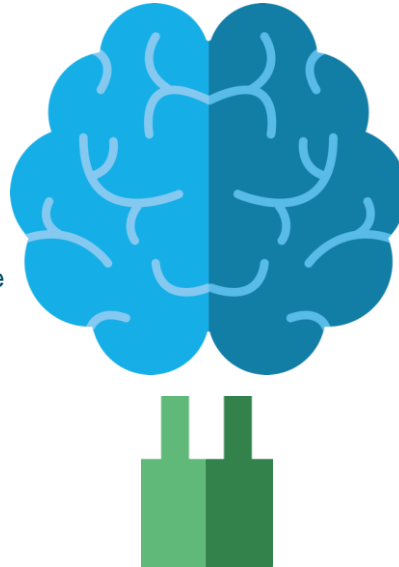
Hands-on experience at the intersection of several disciplines: Electronics, Networking, Coding, Data, Security and Business.

Maker Technologies

Highly engaging hardware kits coupled with the unique Cisco Prototyping Lab app enrich the experience.

Solution Modeling and Prototyping

Use Cisco Packet Tracer to model and simulate IoT Systems and the Cisco Prototyping Lab to quickly develop a proof of concept.



Soft Skills Integration

Stanford School of Design Thinking, Creative problem solving, and 21st century skills: Communication, Collaboration, Creativity and Critical thinking.

Cisco Enterprise Technologies

Cisco FOG computing approach, Cisco Vertical Solutions, and programming using the Cisco Spark API.

Flexibility

Integrate into existing courses or introduce new course(s) appropriate for desired Education level.

IoT Fundamentals Learning Pathways

IoT Fundamentals Course Summary



Course Overview

Benefits

Connecting Things

Students learn how to securely interconnect sensors, actuators, microcontrollers, single-board computers, and cloud services over IP networks to create an end-to-end IoT system.

Students will develop multi-disciplinary skillsets required to prototype an IoT solution for a specific business case with a strong focus on the security considerations for emerging technologies.

Course Delivery: Instructor-led
Estimated Time to Complete: 40-50 hours

Big Data & Analytics

Students will learn how to use Python data libraries to create a pipeline to acquire, transform and visualize data collected from IoT sensors and machines.

The transformative element of any IoT system is the data that can be collected from it. Thus the ability to extract data and using data analytics techniques to gain insights increases employability.

Course Delivery: Instructor-led
Estimated Time to Complete: 40-50 hours

Hackathon Playbook

The Hackathon Playbook is a comprehensive framework of tools and templates to prepare and run a Hackathon as a result of best practices and lessons-learned collected from the global execution of IoT Hackathons within Networking Academy and by other organizers.

Students reinforce and deepen their multidisciplinary IoT and data skills by defining, designing, prototyping and presenting an IoT solution to a panel of industry experts and peers.

Course Delivery: Instructor-led
Estimated Time to Complete: 20-30 hours

IoT Fundamentals

Recommended Pathways



Connect the Unconnected

- Students: connect sensors to the internet via IoT devices in order to produce data useful for automation and making more intelligent business decisions.
- Academy:
 - Easier adoption for secondary students
 - Easier to include within existing programs such as embedded programming, networking, OS&IT

Connections into Insights

- Students: use Python to create a data pipeline to acquire, manipulate and visualize sensor-generated data; see the potential of Machine Learning applications. These skills that are extremely valuable in the job market today.
- Academy:
 - For students with stronger programming and math skills
 - Increase understanding on value creation when using Big Data in the digitization of industries like Manufacturing, Energy, Automobiles



Choose the implementation that best meets your student needs and institutional program, or create your own

Sample Semester-Based Implementations

Connect the Unconnected

Secondary School
Vocational Training
Center
2-Year College

1 Semester



Prototype Sophistication:

IoT prototype connecting sensor to gateway and to cloud service

Connections into Insights

2-Year College
4-Year College

1st Semester



2nd Semester

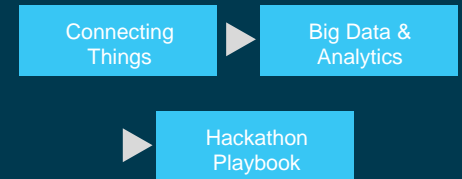


Prototype Sophistication:

IoT prototype connecting sensor to gateway and to cloud service and produce data visualization, data analytics.

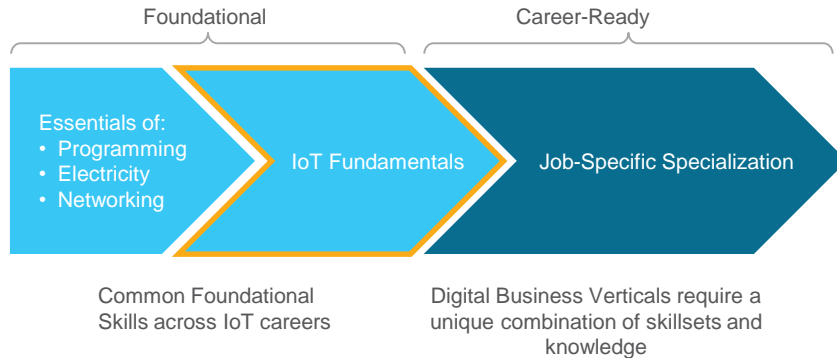
4-Year Engineering
(compressed)

1 Semester

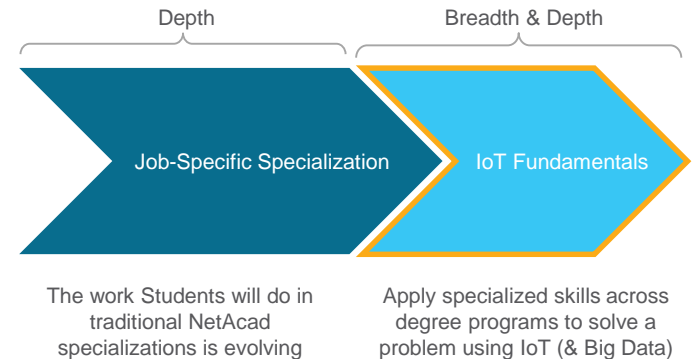


IoT Fundamentals Flexibility

IoT Fundamentals as Path to IoT Specialization

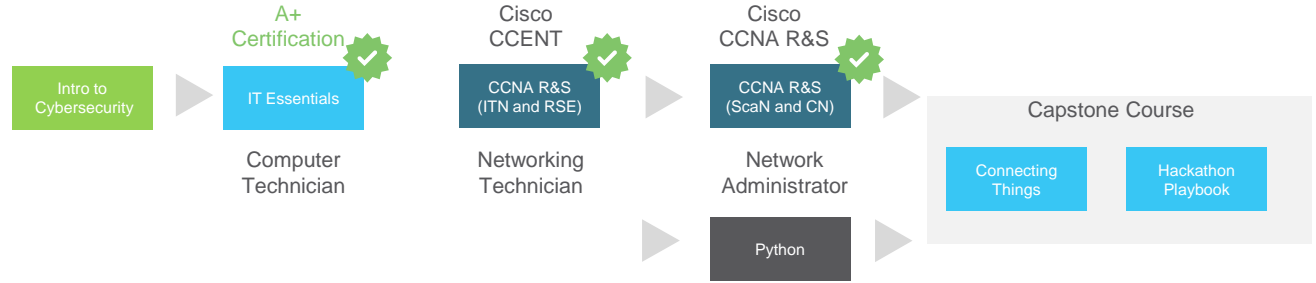


IoT Fundamentals as Capstone to “Digitize” Core Specializations

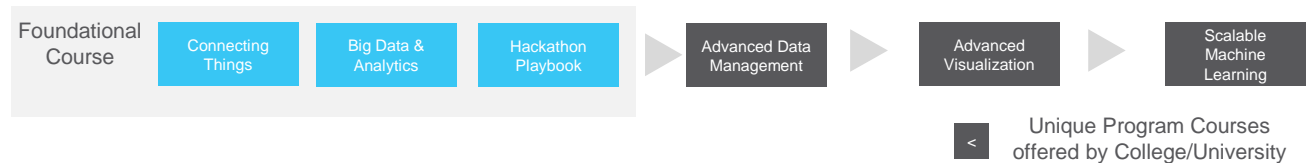


IoT Fundamentals Examples of Career-Ready Pathways

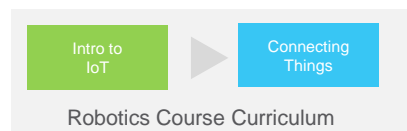
Ex. Infrastructure Program at a 2-Yr / Vocational College



Ex. Data Science program at 4-Yr College/University



Ex. Robotics program at Secondary School



Unique Skills for entry into post-secondary degree or training programs, for ex.
 Engineering IoT Infrastructure Data Science Cybersecurity



IoT Fundamentals Academy support resources include shared implementation scenarios across our community

 Certification

Learning Paths Details

Feature	Connect the Unconnected	Connections into Insights	Connections into Insights (compressed)
Description	Starter Path	Extended Path	Compressed Path
Target Audience	Secondary Schools Vocational Training Centers 2-Year Colleges Maker Spaces	2-Year Colleges 4-Year Colleges Universities	4-Year Engineering Program
Instructional Hours	70 hours	140 hours	70 hours
Path in semester structure	1 Semester: Connecting Things + Hackathon	1st Sem: Connecting Things + Hackathon (70) 2nd Sem: Big Data & Analytics + Hackathon (70)	1 Semester: Connecting Things + Big Data & Analytics + Hackathon
Prototype Sophistication	IoT prototype connecting sensor to gateway and to cloud service	IoT prototype connecting sensor to gateway and to cloud service, producing data visualization, performing data analytics	IoT prototype connecting sensor to gateway and to cloud service, producing data visualization, performing data analytics

Getting Ready for IoT Fundamentals

Recommended Entry Knowledge

Recommended pre-requisite knowledge for IoT Fundamentals:

- Basic TCP/IP networking including cabling and connecting devices in a LAN and to the internet.
- Familiarity with Cisco Packet Tracer, a network and IoT devices simulation application.
- Experience using any programming language to solve basic algorithmic problems.
- Foundational knowledge of physics including current, voltage, resistance, and power.

Note:

While not mandatory, taking one or more of the following Networking Academy courses enhances student learning:

Networking (one or more of the following)

- Networking Essentials
- CCNA R&S: Introduction to Networks
- IT Essentials

Programming

- PCA: Programming Essentials in Python
(coming soon!)

Security

- Cybersecurity Essentials

Packet Tracer

- Introduction to Packet Tracer



IoT Fundamentals contains optional refresher material for the above skills within the instructional flow

IoT Fundamentals

Instructor Training Requirements

Recommended Qualifying Skills

- Basic TCP/IP networking including cabling and connecting devices in a LAN and to the Internet.
- Familiarity with Cisco Packet Tracer, a network and IoT devices simulation application.
- Experience using any programming language to solve basic algorithmic problems.
- Foundational knowledge of physics including current, voltage, resistance, and power.

Recommended Experience

- Teaching Quantitative problem solving skills
- Business context (Professional non-academic work experience or guest speakers)

Instructor Training & Support:

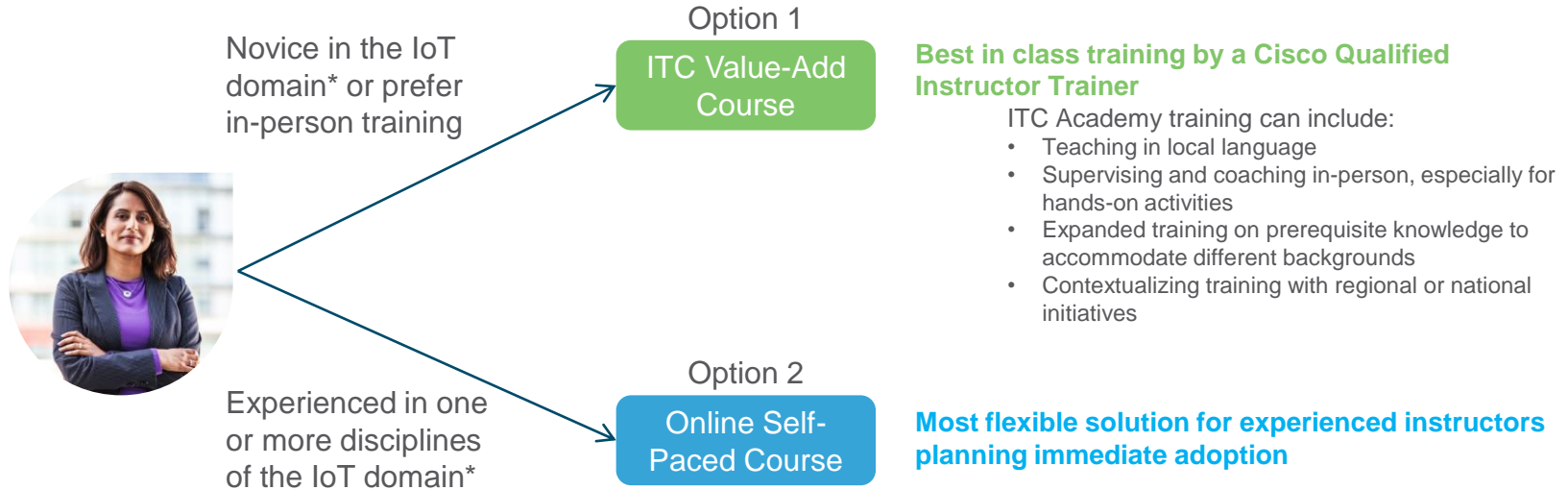
1. Academies must align with an ASC.
2. Instructor Training is required for Connecting Things and Big Data & Analytics.
3. Instructors can register for training with an ITC.
or Enroll in a self-paced basic training course on their own.

NOTES:

Access enrollment links on the IoT Fundamentals Resources page on Netacad.com



Instructor Training Options



* Ex. Maker, Teacher of embedded computing or electronics

IoT Fundamentals

Scope & Sequence



IoT Fundamentals

Curriculum Scope and Sequence

Last updated 9 October 2017

Introduction

Cisco Networking Academy's IoT Fundamentals curriculum provides students with a comprehensive understanding of the Internet of Things (IoT). It develops foundational skills using hands-on lab activities that stimulate the students in applying creative problem-solving and rapid prototyping in the interdisciplinary domain of electronics, networking, security, data analytics, and business. The student-centric approach translates into the student being able to ideate, design, prototype and present an IoT solution for an identified business or society need.

The interconnection of previously unconnected devices to the internet and the analysis of the data they generate are having a disruptive and transformational effect on every industry around the world. IoT is the technology that is narrowing the distance between the physical world and the digital world¹, and creating unprecedented automation in every industry. In parallel, this newly digitized world generates an increasing amount of data that can be mined to gain insights or automate smart behaviors. The

Available on
[Netacad.com](https://www.netacad.com)

[Resources >](#)
[Course](#)
[Resources](#)

IoT Learning Opportunities

Here are some Cisco NetAcad resources to learn more about IoT and digitization.



IPD Week

The [IPD week](#) live events and recordings offer many sessions related to IoT and the IoT Fundamentals curriculum.



Cisco White Paper

[“Attaining IoT Value: How To Move from Connecting Things to Capturing Insights”](#)



NetAcad Webinars

Instructors and students have access to [Technology webinars](#) with series on Cisco Meraki, Software-Defined Networks, and more.

IoT Fundamentals Curriculum Details

Business Skills for New Global Problem Solvers



Innovation

Design Thinking

Adaptability

Collaboration

Global Mindset

Synthesizing Data

Problem Solving

Interdisciplinary, Project-Based Problem Solving



Electronics

Networking

Programming

Design

Fabrication

Prototyping

Troubleshooting

Big Data /
Analytics

Data
Visualization

IoT Fundamentals: Connecting Things

Course Overview

In Connecting Things, students learn how to securely interconnect sensors, actuators, microcontrollers, single-board computers, and cloud services over IP networks to create an end-to-end IoT system.

Benefits

Students will develop the interdisciplinary skillsets required to prototype an IoT solution for a specific business case with a strong focus on the security considerations for emerging technologies.

Learning Components

- Understand and explain the concepts, opportunities and challenges of digital transformation using IoT.
- Interconnect sensors/actuators, microcontrollers (Arduino), Single Board Computers (Raspberry Pi) and cloud services (Cisco Spark restful API) to create an end-to-end IoT system.
- Understand the relevant aspects of cybersecurity and privacy for an IoT solution.
- Understand how digitalization is changing vertical markets such as manufacturing, energy, and smart cars.
- Use simulation tools (Packet Tracer) to create end-to-end IoT system.



Features

Target Audience: Secondary, Vocational, 2-year and 4-year College, 4-Year University students

Prerequisites: Basic programming, networking and electronics

Instructor Training Requirement: Yes

Languages: English

Course Delivery: Instructor-led

Estimated Time to Complete: 40-50 hours

Recommended Next Course: IoT Fundamentals: Big Data & Analytics or Hackathon Playbook

IoT Fundamentals: Connecting Things

Course Details

Target Audience

Appropriate for students familiar with networking technology and software programming who are interested in using digitization to help solve some of the world's most challenging problems

Entering Knowledge

Fundamental knowledge of any programming language with exposure to variables, arithmetic, logic, loops, and functions

Fundamental knowledge of physics covering current, voltage, resistance, and power

Learning Outcomes

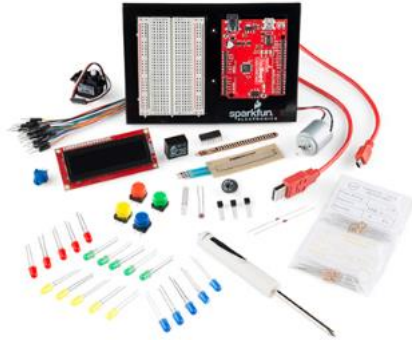
Learn basic prototyping techniques

Learn basic Python programming

Build an end-to-end prototype

Build an IoT Systems solution

Diagram a business model for a given business or social endeavor using the Business Model Canvas



Tools:

Raspberry Pi

Arduino

Prototyping Lab

Packet Tracer

Connecting Things Course Outline

Chapter	Chapter Titles	Summary Description
1	Things and Connections	Understand the building blocks, the interconnections and the information flow of an IoT System.
2	Sensors, Actuators and microcontrollers	Use sensors and an Arduino microcontroller to read data from physical world and control actuators.
3	Software is Everywhere	Use Python to program a Single Board Computer (Raspberry Pi) to perform more complex embedded program.
4	Fog Networks and Cloud Computing	Learn the principal IoT Networking Protocols. Learn how an IoT system distributes computing between Fog and Cloud networks. Learn how to interconnect systems using RESTful APIs.
5	IoT Applications in Business	Learn how IoT technologies are applied in diverse vertical markets: Healthcare, Smart Cities, Smart Grid, Manufacturing.
6	Create an IoT Solution	End-to-End case study on how to create an IoT Prototype.

IoT Fundamentals: Big Data & Analytics

Course Overview

Students will learn how to use Python data libraries to create a pipeline to acquire, transform and visualize data collected from IoT sensors and machines.

Benefits

The transformative element of any IoT system is the data that can be collected from it. Thus the ability to extract data and using data analytics techniques to gain insights increases employability.

Learning Components

- Use Python to read data from sensors and store data in a SQL data base.
- Use Python Data Analysis library to clean, manipulate, integrate data sets.
- Use Python Visualization Libraries to visualize real-time data and explore acquired data sets.
- Explain the fundamental principles of a modern scalable Big Data platforms like Hadoop.
- Use storytelling to present the insights gained from extracted data.



Features

Target Audience: 2-year and 4-year College, 4-Year University students

Prerequisites: IoT Fundamentals: Connecting Things

Instructor Training Requirement: Yes

Languages: English

Course Delivery: Instructor-led

Estimated Time to Complete: 40-50 hours

Recommended Next Course: IoT Fundamentals: Hackathon Playbook

IoT Fundamentals: Big Data & Analytics

Course Details

Target Audience

Appropriate for students familiar with software programming who are interested in hands-on experience of manipulating descriptive, predictive and prescriptive data-analysis methodologies

Entering Knowledge

Fundamental knowledge of any programming language with exposure to variables, arithmetic, logic, loops, and functions

Familiar with the design, implementation and debug of simple programs

Learning Outcomes

Describe the various systems that support a typical data center

Explain how server virtualization consolidates idle resources, reduces cost and provide better services to the business

Explain how the Software Defined Networking (SDN) framework plays the key role in data center virtualization

Understand the steps of the Data Analysis Lifecycle and perform these tasks in 4 different labs using the RapidMiner and RStudio data analytics tools



Big Data & Analytics Course Outline

Chapter	Big Data & Analytics	Summary Description
1	Data and the Internet of Things	Understand the concepts of Big Data & Analytics, and the role of Big Data in IoT systems.
2	Fundamentals of Data Analysis	Learn the basics of descriptive statistics, the practical aspects in acquiring data from a sensor and how to create visual representations of the data.
3	Data Analysis	Explore data using statistics and visualization to extract information and create hypotheses.
4	Advanced Data Analytics and Machine Learning	Learn about predictive analytics, the supervised and unsupervised approaches to machine learning and how to apply models to make predictions from the data.
5	Storytelling with Data	Learn how to transform analytics results into a clear and convincing narrative and visual communication.
6	Architecture for Big Data and Data Engineering	Learn the basic principles behind the most important scalable solutions for Big Data such as Apache Hadoop and the related ecosystem of technologies.

IoT Fundamentals: Hackathon Playbook

Course Overview

The Hackathon Playbook is a comprehensive framework of tools and templates to prepare and run a Hackathon as a result of best practices and lessons-learned collected from the global execution of IoT Hackathons within Networking Academy and by other organizers.

Benefits

Students reinforce and deepen their multidisciplinary IoT and data skills by defining, designing, prototyping and presenting an IoT solution to a panel of industry experts and peers.

Learning Components

- Inspiration: understand, select and present the problem to be solved to recruit fellow partners.
- Ideation: invent a concept that doesn't already exist to solve a social issue. Learn how to present the solution to experts who will mentor students.
- Prototyping: create a prototyping action plan, including objects and visuals to illustrate their plan and will help an expert understand the concept and prototyping needs.
- Testing: present the concept and validate the prototype with a second expert, including user experience and enhancements.
- Presentation: present the solution and demo the prototypes to an expert panel.



Features

Target Audience: Secondary, Vocational, 2-year and 4-year College, 4-Year University students

Prerequisites: IoT Fundamentals: Connecting Things and/or Big Data and Analytics

Instructor Training Requirement: No

Languages: English

Course Delivery: Instructor-led

Estimated Time to Complete: 20-30 hours

Recommended Next Course: any Career-Ready offering from Cisco or an industry IoT training program

IoT Fundamentals: Hackathon Playbook Course Details

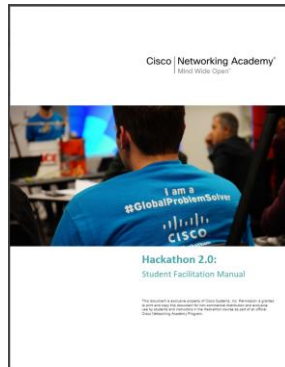


Description

A set of best practices and lessons-learned collected from the global execution of numerous IoT hackathons

Target Audience

Appropriate for students familiar with networking technology and software programming who are interested project-based learning based on IoT technology



Entering Knowledge

Familiar with basic prototyping techniques

Fundamental knowledge of Python programming language

Learning Outcomes

Inspiration: select and present the problem to be solved

Ideation: present the solution to the different experts

Prototyping: create prototype action plan including objects and visuals

Testing: present the concept and validate prototype

Presentation: present the solution to the judging panel and demo the prototypes

Welcome to the Hackathon Playbook course!

This course contains all of the information needed for facilitators and students to conduct a Hackathon.

[Click here to start](#)



IoT Fundamentals Learning Tools

Cisco Prototyping Lab

Tool Overview

The Cisco Prototyping Lab is a comprehensive learning environment created by Cisco for Networking Academy students to learn and practice key aspects of the foundational IoT technologies. Using an engaging, hands-on approach, it supports both the learning and creative phases of the Networking Fundamentals curriculum.

Career Prep

Provides an easy to use, comprehensive learning environment using real devices, code, coding tools and data that students use to create the physical interconnection of an end-to-end IoT and the logical data pipeline to acquire, analyze and present data.

Learning Components

- Prototyping Lab App
- Prototyping Lab Kit
 - Raspberry Pi 3 CanaKit Ultimate Starter Kit (or equivalent)
 - SparkFun Inventor's Kit for Arduino (or equivalent)
 - Cables, sensors & actuators

Features

As an integral part of the Networking Academy learning experience, Cisco Prototyping Lab provides

- Interactive labs using Jupyter Notebook
- Visual programming with Blockly
- Device programming with Python
- Data visualization & analytics
- Connected applications via APIs
- Rapid Prototyping



Packet Tracer

Tool Overview

Packet Tracer is an innovative simulation and visualization tool used for lectures, labs, games, homework, assessments, and competitions. It is embedded in these courses:

- CCNA Routing and Switching
- CCNA Security
- IT Essentials
- Intro to the Internet of Things
- Mobility Fundamentals

Career Prep

The Packet Tracer simulation-based learning environment promotes the development of essential career skills ranging from teamwork and critical thinking to creative problem solving.

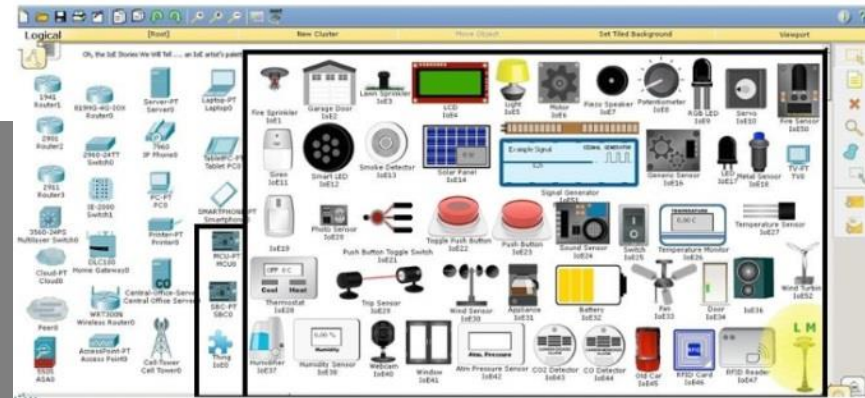
Learning Components

- Cisco Packet Tracer (PT)
- PT Mobile Android
- PT Mobile iOS
- PT Games

Features

As an integral part of the Networking Academy learning experience, Packet Tracer provides

- Simulation
- Visualization
- Authoring
- Assessment
- Collaboration capabilities and facilitates the teaching and learning of complex technology concepts.





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turning the perfect
storm into global
opportunities

<https://www.netacad.com/>

