



IoT Fundamentals

Turning the perfect storm into global opportunities

Tobias Koeppel, Eugene Morozov

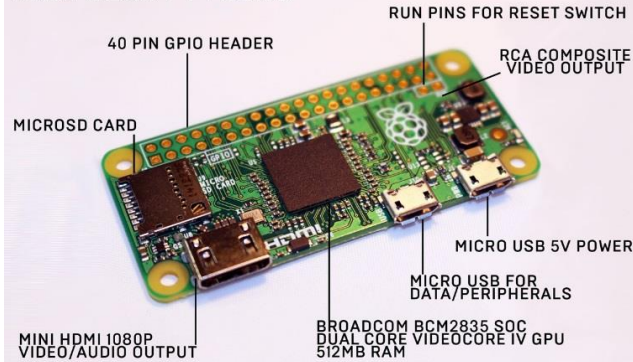
22 September 2017
Aachen

#NetAcadIPD

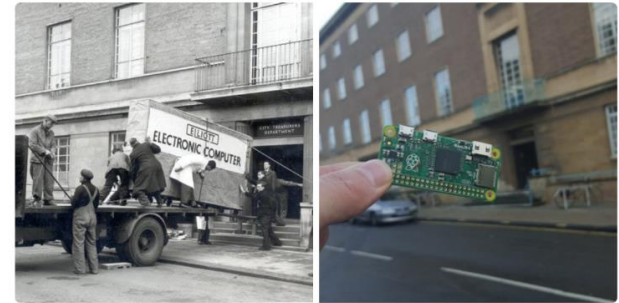


Raspberry Pi Zero – a \$5 computer

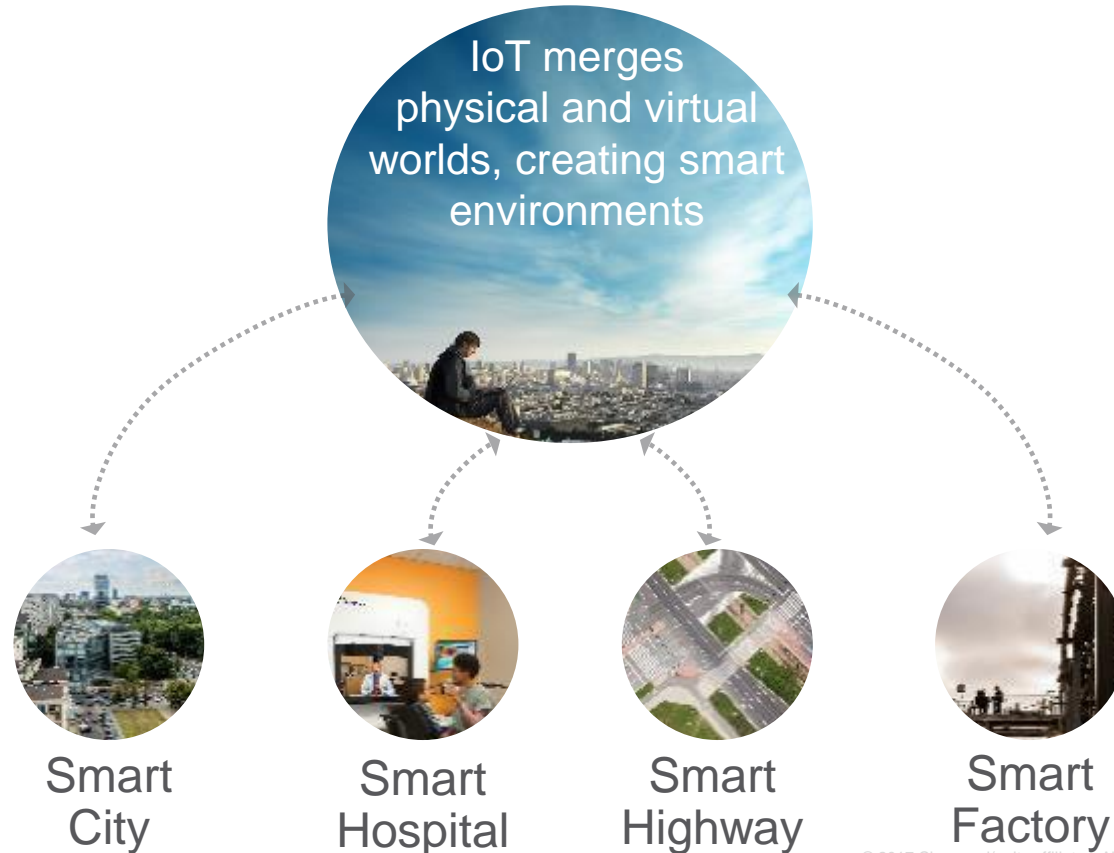
RASPBERRY PI ZERO



58 Years on...



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

The Networking Academy Learning Portfolio

Current & Planned

 Certification-aligned
 * Available within 12 months

Collaborate for Impact

Packet Tracer
Know How

Packet Tracer

Hackathons

Regional
IT Competitions

NetRiders

Internships

Exploratory

Foundational

Career-Ready




Networking

Introduction to Cybersecurity

Cybersecurity Essentials

CCNA R&S

Intro to Networks
Scaling Networks

R&S Essentials,
Connecting Networks 

CCNP R&S

Switch

Route

TShoot 



Security

Introduction to IoT

IoT Fundamentals

Connecting Things*
Big Data and Analytics*
Hackathon Playbook*

CCNA Security 

CCNA Cyber Ops* 



IoT

NDG Linux Unhatched

NDG Linux Essentials 



IT Essentials 



NDG Linux I 

NDG Linux II 



OS & IT

Programming Essentials in C 
 Programming Essentials in C++ 
 Python*

Programming in C* 
 Programming in C++* 



Programming

Be Your Own Boss

Entrepreneurship



Business

Get Connected



Digital
Literacy

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: Connecting Things

Course Overview

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 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.

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

Languages: English

Course Delivery: Instructor-led

Estimated Time to Complete: 40-50 hours

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

Instructor Training: Required

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

Prerequisites: IoT Fundamentals: Connecting Things

Languages: English

Course Delivery: Instructor-led

Estimated Time to Complete: 40-50 hours

Recommended Next Course: IoT Fundamentals: Hackathon Playbook

Instructor Training: Required

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

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

Instructor Training: Required

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 v3.2 (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.

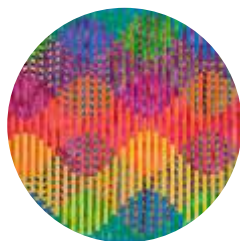


IoT Fundamentals Approach

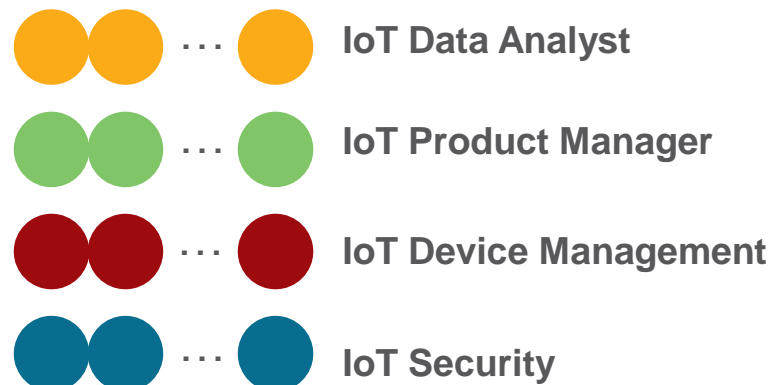
A Multidisciplinary Digital Foundation

...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 Recommended Pathways

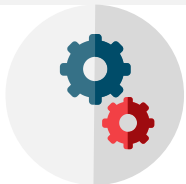


Connect the Unconnected

- 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

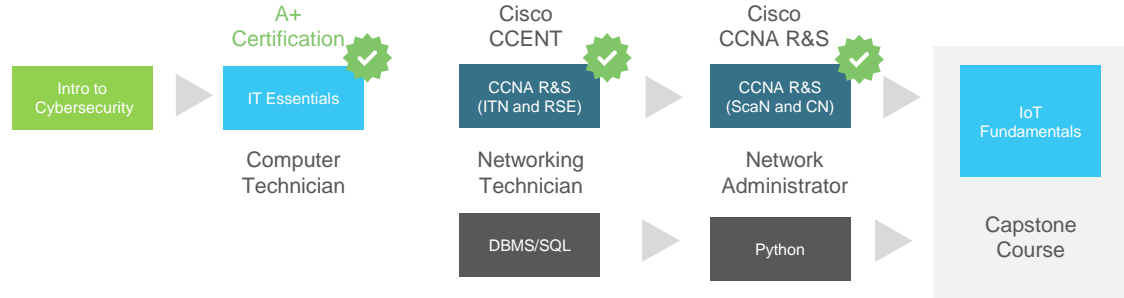
- Students: use Python to create a data pipeline to acquire, manipulate and visualize sensor-generated data; see the potential of Machine Learning applications. These skills that are extremely valuable in the job market today.
- Academy:
 - For students with stronger programming and math skills
 - Increase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



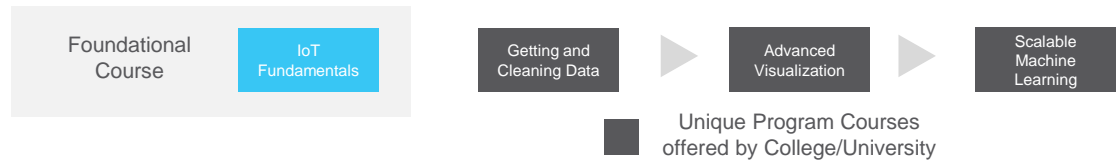
Choose the implementation that best meets your student needs and institutional program, or create your own

IoT Fundamentals Examples of Career-Ready Pathways

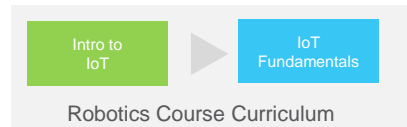
Ex. Infrastructure Program at a 2-Yr / Vocational College



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

Recommended Entry Knowledge

Recommended pre-requisite knowledge for IoT Fundamentals:

- Familiarity Basic TCP/IP Networking including cabling and interconnecting devices in Ethernet LAN and to Internet.
- Familiarity with Cisco Packet Tracer, a network and IoT devices simulation application
- Foundational knowledge of Python or any other imperative programming language to solve basic algorithmic problems
- Foundational knowledge of physics including current, voltage, resistance, and power.

Note:

Although not mandatory, student learning will be amplified if the students have completed one or more of the following Networking Academy Courses:
One course from our Networking Product Line:

- Networking Essentials | CCNA 1 Introduction to Networks | IT Essentials
- Python course (coming soon!)
- Cybersecurity Essentials
- PT Know How
- Introduction to IoT



IoT Fundamentals contains optional refresher material for the above skills when needed at the start of each chapter

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:

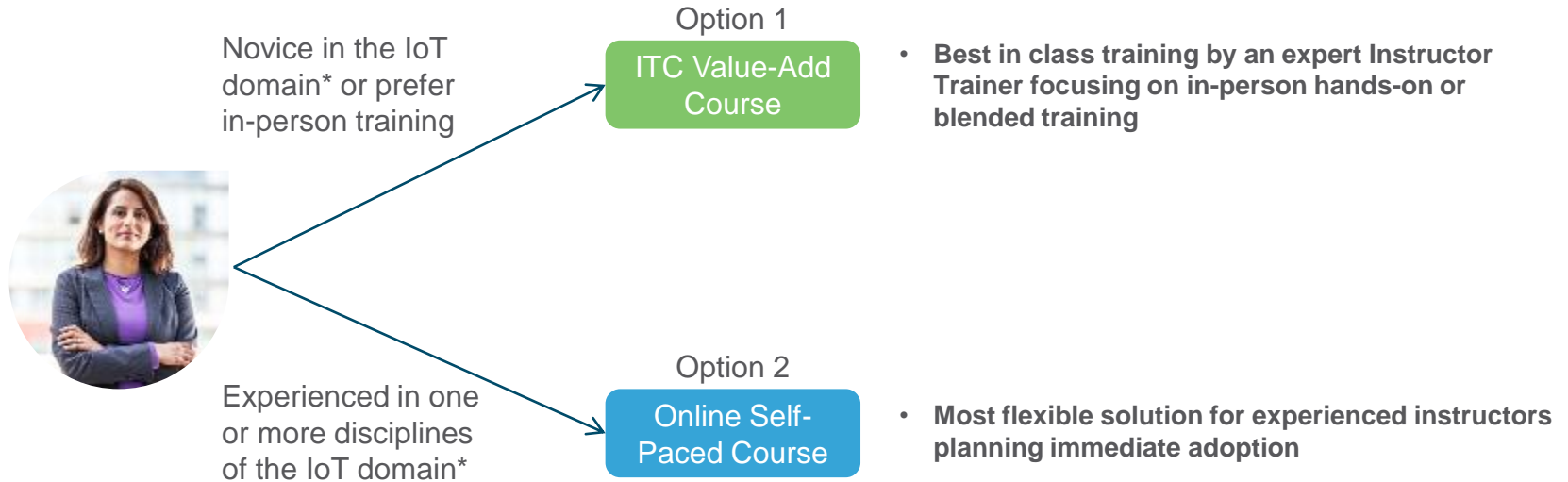
1. Academies must align with an ASC.
2. Instructor Training is required.
3. Instructors can enroll in a self-paced basic training course on their own or register for training with an ITC.

NOTE:

IoT Fundamentals Limited Availability instructors are accredited to teach v2.0 with no additional instructor training. Limited Availability Instructor Trainer participants are also qualified to create ITC courses for v2.0.



IoT Fundamentals Instructor Training Options



* Ex. Maker, Teacher of embedded computing or electronics

IoT Fundamentals: Connecting Things Demo

A New NetAcad Hands-On Experience

IoT Fundamentals | Lab Experiences



Analyze the Problem
with User Focus



Hands-on Design and
Maker Mindset



Rapid Prototyping, Iterating,
Presenting

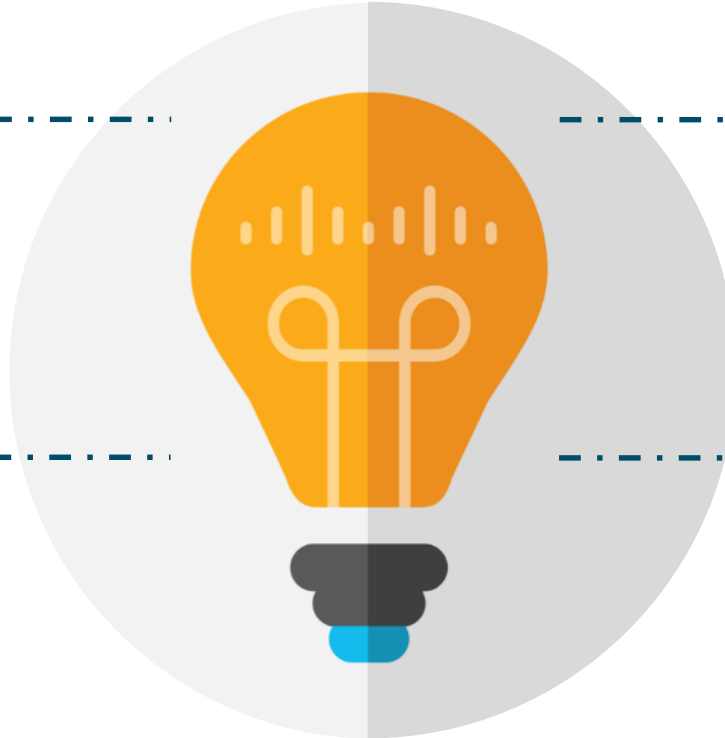
Doing IoT

Workshops¹

Creathons²

Packathons²

Hackathons^{1,2}

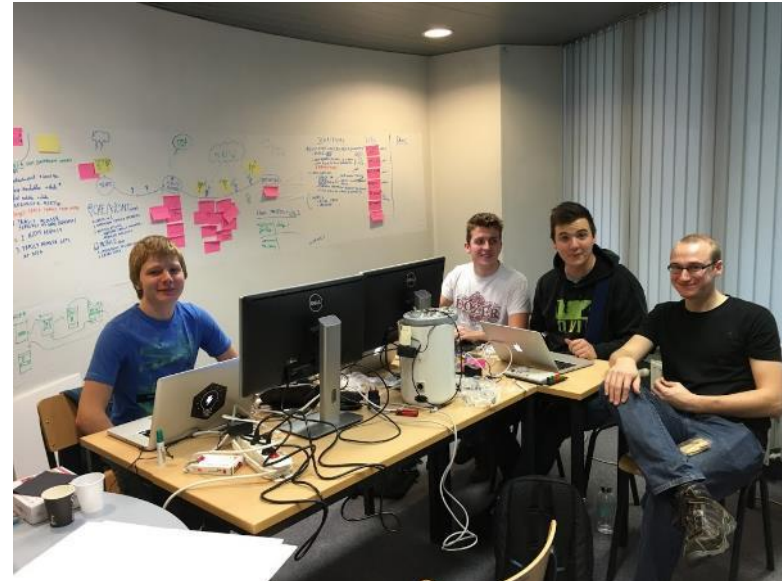


1 May use Prototyping Lab App
2 Based on the Hackathon Playbook

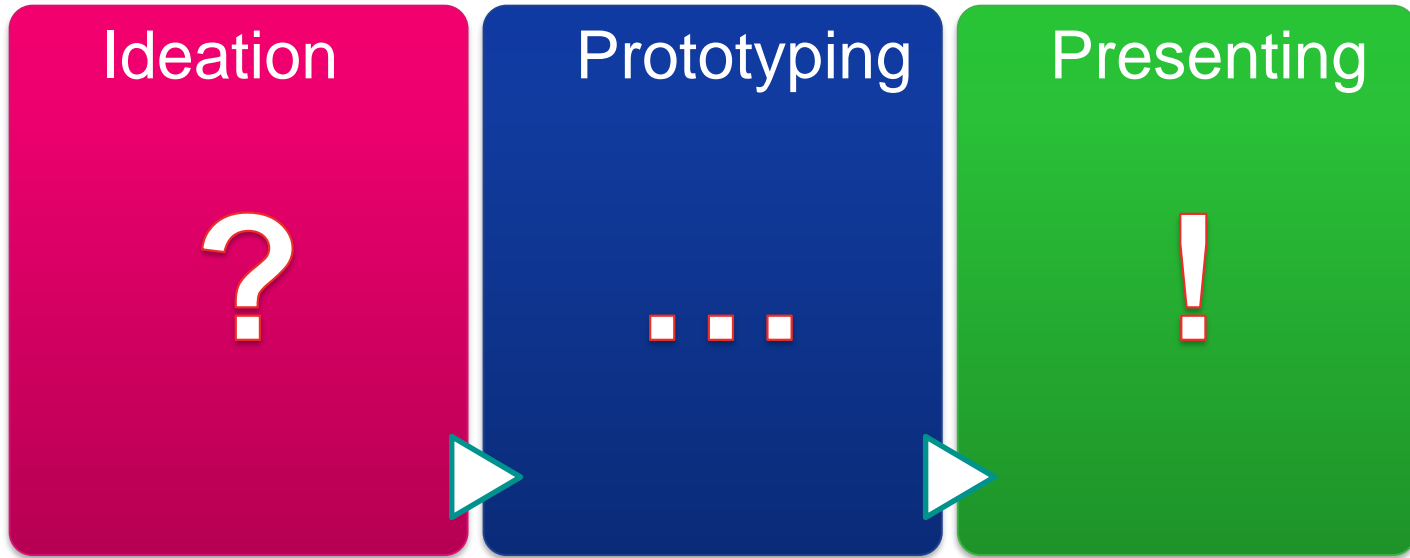
Overview

Hackathon

- A 3-day activity on prototyping an IoT system
- Builds technical and soft skills
- Uses Raspberry Pi, Arduino, and other hardware
- Students focus on prototyping a smart IoT device
- May leverage PL App



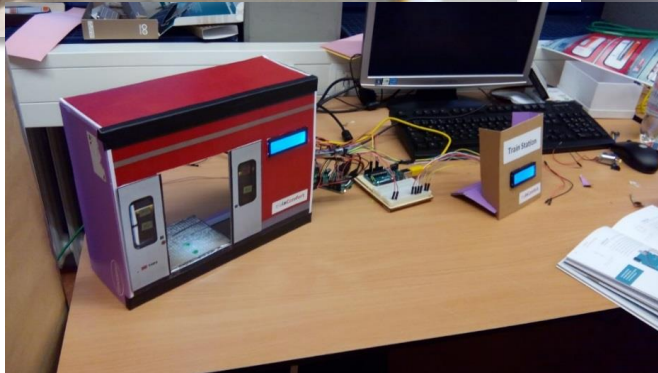
Hackathon Phases



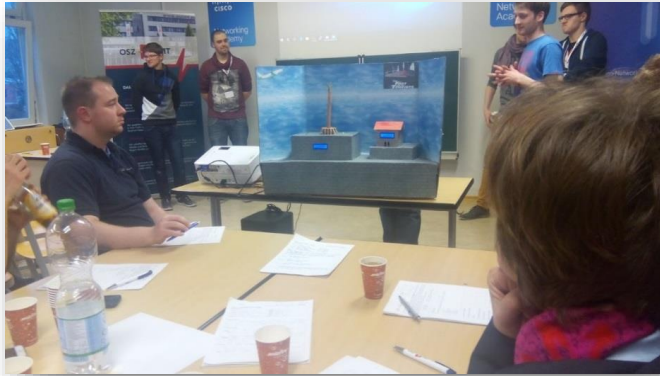
Ideation



Prototyping



Presenting



Overview

Creathon

- 1-2 day activity on finding an IoT solution
- An opportunity for students to further their understanding of IoT and build soft skills
- Conduct deep research and business analysis



Overview

Packathon

- A 2-3 day activity on modeling an IoT solution
- Build technical and soft skills
- Based on Packet Tracer,
doesn't use real equipment
- Create a complete end-to-end
IoT solution entailing multiple IoT devices





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
Emerging Tech Workshop: Network Programmability*



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*

Emerging Tech Workshop: Collaboration / Spark API*



CLP: Advanced Programming in C*



CPP: Advanced Programming in C++*



Business



Be Your Own Boss



Entrepreneurship



Digital Literacy



Get Connected