

FERIT Osijek: ICT and Startup Scene, Automotive Computing and Communications Master Study Programme – Part I

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CROATIA

Lecture outline

- Introduction
- Startups and Companies in ICT
- Main Challenges in ICT Today
- Answering to Main Challenges in ICT
- Answering to Main Challenges in ICT – FERIT Osijek
- Key takeaways





TeamSoc21
The ICT Engineer of the 21st Century

Introduction

Introduction

- In this lecture we'll try to present the following:
 - to refresh your view about startups and ICT companies in startup ecosystem
 - to point out main challenges, requirements and issues in ICT today
 - to suggest the possible answers to main challenges and issues in ICT through Osijek ICT and startup ecosystem and scene
 - to conclude with main technical, societal and business aspects of the topic



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Startups and Companies in ICT

Startups

- a company initiated by individual founders or entrepreneurs to search for a repeatable and scalable business model
- founders design startups to effectively develop and validate a scalable business model
- the concepts of startups and entrepreneurship are similar. However, **entrepreneurship refers all new businesses**, including self-employment and businesses that never intend to grow big or become registered, while **startups refer to new businesses that intend to grow beyond the solo founder, have employees, and intend to grow large**
- startups face **high uncertainty** and do have **high rates of failure**, but the minority that go on to be successful companies **have the potential to become large and influential**. Some startups become unicorns, i.e. privately held startup companies valued at over \$1 billion.

Startup Actions

- models behind startups presenting as ventures are usually associated with design science or **design principles considered to be a coherent set of normative ideas and propositions to design and construct the company backbone** (e.g. "affordable loss,")
- it's **better to first make a must-have for a small number of users** (early adopters) than a **nice-to-have for a large number of users. It is much easier to get more users than to go from nice-to-have to must-have.**

Design Principles

- startups are mostly **started by a founder** (solo-founder) or **co-founders who have a way to solve a problem**
- the founder(s) begin with **market validation** by problem interview, solution interview, and building a minimum viable product (MVP), i.e. a **prototype, to develop and validate** their **business models**
- **startup process can take a long period of time** (by some estimates, three years or longer), and hence **sustaining effort is required**. Sustaining effort over the long term is especially challenging because of the high failure rates and uncertain outcomes

Heuristics and Biases in Startup Actions

- **lack of information, high uncertainty, the need to make decisions quickly - founders of startups use lots of heuristics** and exhibit biases in their startup actions
- biases and heuristics: cognitive toolboxes and decision making process, but sometimes erroneous and fallacious
- **entrepreneurs often have illusion of control of the startup**, but really they tend to believe they have more degree of control they have over events, discounting the role of luck

Heuristics and Biases in Startup Actions

- some of the most important decision biases of entrepreneurs in start up a new bussines:
 1. **Overconfidence**: Perceive a subjective certainty higher than the objective accuracy.
 2. **Illusion of control**: Overemphasize how much skills, instead of chance, improve performance.
 3. **The law of small numbers**: Reach conclusions about a larger population using a limited sample.
 4. **Availability bias**: Make judgments about the probability of events based on how easy it is to think of examples.
 5. **Escalation of commitment**: Persist unduly with unsuccessful initiatives or courses of action.
- startups **use a number of action principles** (lean startup) to **generate** evidence as quickly as possible to **reduce the downside effect of decision biases** such as escalation of commitment, overconfidence, and illusion of control

Mentoring

- many entrepreneurs seek **feedback from mentors** in creating their startups. Mentors guide founders and impart entrepreneurial skills and may increase self-efficacy of the nascent entrepreneurs

Startup Principles

- Lean Startup
- Market Validation
- Design Thinking
- Decision-Making under Uncertainty
- Partnering
- Entrepreneurial Learning
- Business Model Design

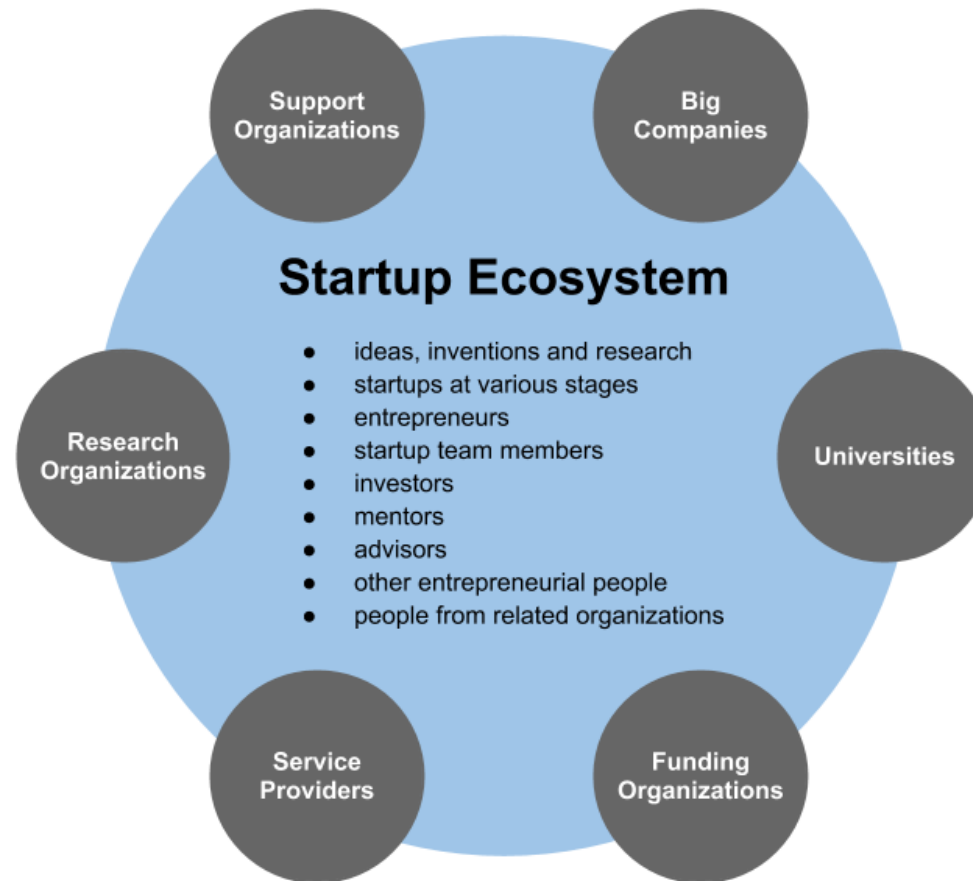
Founders/Entrepreneurs

- (co)founders are involved in the **initial launch of startup companies**
- **anyone can be a co-founder**, and an existing company can also be a co-founder, but the most common co-founders are **founder-CEOs, engineers, hackers, web developers, web designers and others involved** in the ground level of a new, often venture
- the founder that is **responsible for the overall strategy of the startup** plays the role of **founder-CEOs**, much like CEOs in established firms
- (co)founder definition and rules are not always clear and sometimes are regulated

Startup Timing

- formal and informal education
- **startup courses** are from: traditional **economic, business** or **information technology**
- startups are **often targeted to software** and **use software development and business basics** from this domain
- startup requires **patience** and **resilience** and training should also have business and psychological components (**learning from experience and successful cases**)
- lack of resources and with no operation history: **learning through mock-up startups which try to simulate real startups challenges**

Startup Ecosystem



By Vc20 - Startup Ecosystem Whitepaper with credit to startupcommons.org, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=25932925>

Startup Ecosystem

- The startup ecosystem consists of:
 - **the individuals** (entrepreneurs, venture capitalists, angel investors, mentors, advisors)
 - **institutions and organizations** (research universities and institutes, business schools and entrepreneurship programs and centres operated by universities and colleges, non-profit entrepreneurship support organizations, government entrepreneurship programs and services, Chambers of commerce)
 - **business incubators and business accelerators** and top-performing entrepreneurial firms and startups
 - region with all of these elements is considered to be a "strong" startup ecosystem (e.g. startup ecosystems is Silicon Valley, CA, USA, Boston, MA, USA, Berlin, D - companies and universities)

Startup Ecosystem

- startups are created **in all types of businesses**, and all over the world
- ICT related startups started with selling Internet access and related service, but currently startups are targeted to very **sophisticated ICT solutions** and related to **big challenges**

Startup Investing

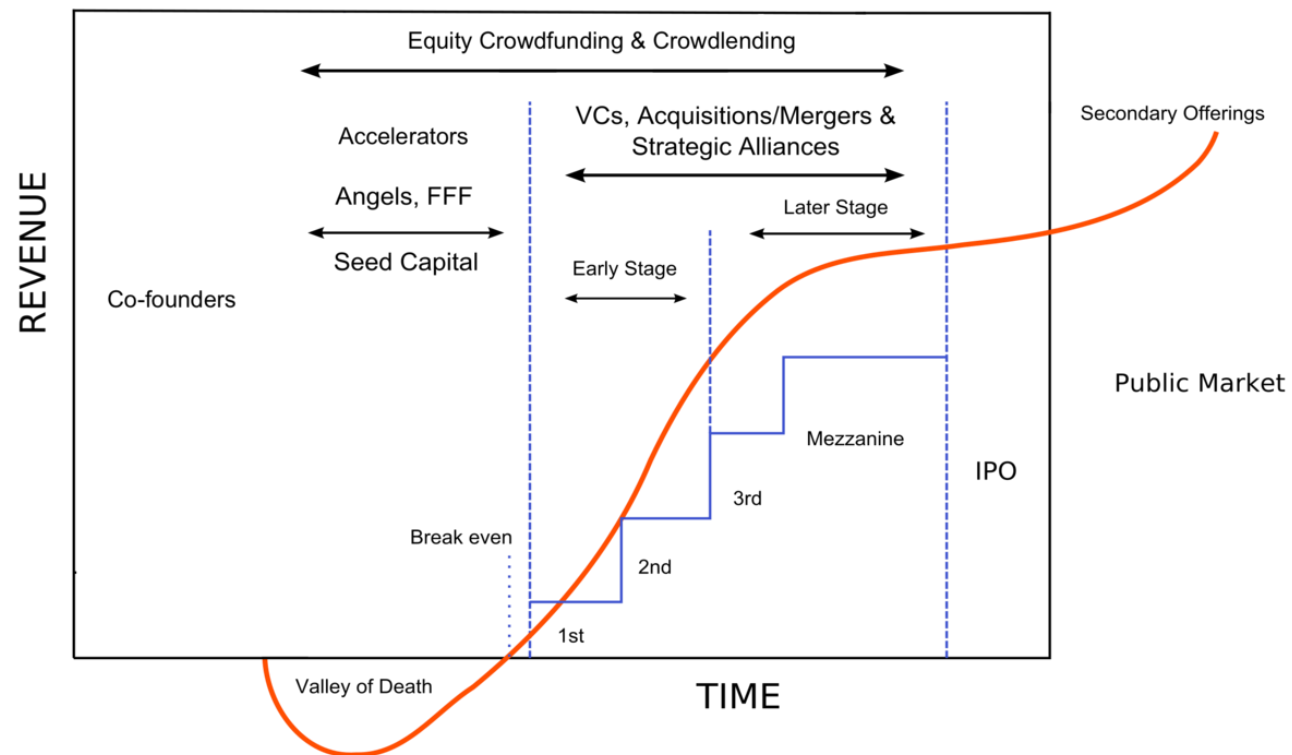
- **investment in an early-stage company** (the startup company) made from **(co)founders** and **additional investors at different stages of growth**
- **investors** have strong co-founding team, **make balance between risk and reward, estimate scalability of startup activity**, but
- **attractive startups often have lower self-funding by the founders, higher risk, higher potential return on investment, higher scalability independently of the growth of the capital market, labor or country economy, but investment time is very important**
- funding options:
 - revenue-based financing
 - venture capital firms and angel investors
 - funded by the founders themselves ("bootstrapping,,)
 - factoring
 - crowdfunding

Startup Investing

- necessity of funding is different for different startups (some don't need funding)
- **intellectual property protection** for new idea is very important
- investing rounds:
 - seed round (prototype) - **angels**
 - series A (some revenue) – **venture capital companies or super angels**
 - series B, C and D (leading towards the Initial Public Offering) - **venture capital firms, private equity firms**
- **on-line investment**: to access capital and to increase deal flow and centralize all the process

Startup Investing

Startup Financing Cycle



Kmuehmel, VC20 -

https://commons.wikimedia.org/wiki/File:Startup_financing_cycle.svg

Startups in Comics

<https://www.tbsplanet.com/5-comic-strips-depicting-passion-drives-startups/>

Main Challenges in ICT Today

Main Challenges

5G and Future Internet

IoE

Big Data

Artificial Intelligence

Cyber-Physical Systems

Industry 4.0

Robotics

Cyber-Security

Blockchain

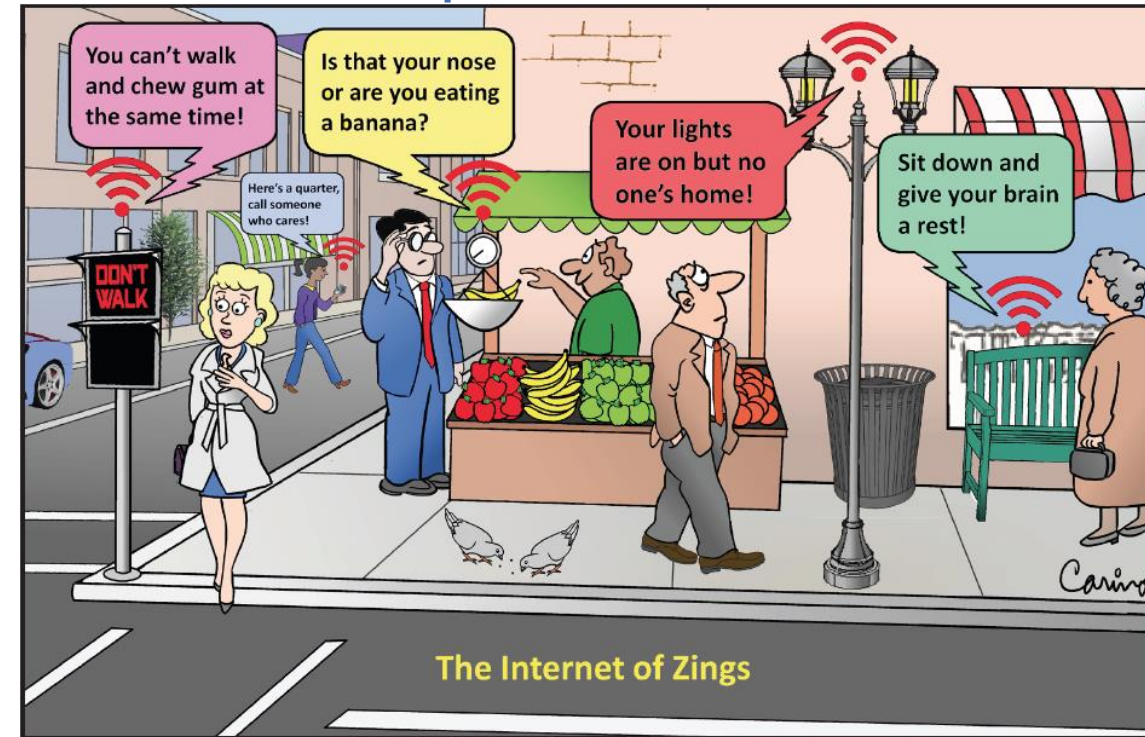
Quantum Computing

....

⇒ COMBINATION OF MANY APPROACHES

5G and Future Internet

- next generation of mobile internet connectivity, offering **faster speeds** and **more reliable connections** on smartphones and other **devices** than ever before
- **fears!?**



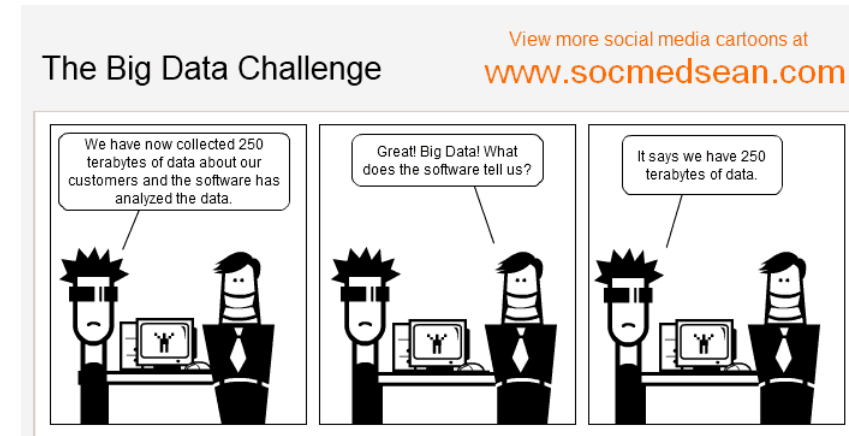
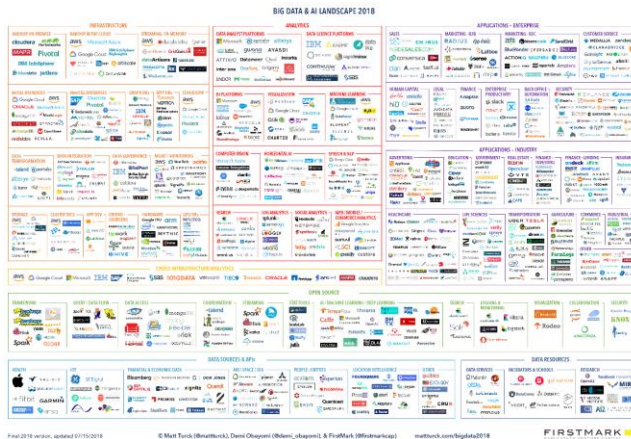
IoE (Internet of Everything)

- devices and consumer products **connected to the Internet** and outfitted with expanded digital features
- many different types of appliances, devices and items connected to the global internet
- from **digital sensor tools/interfaces used for remote appliances to smarter and more well-connected mobile devices, industrial machine learning systems and other types of distributed hardware** that have recently become **more intelligent and automated**



Big Data

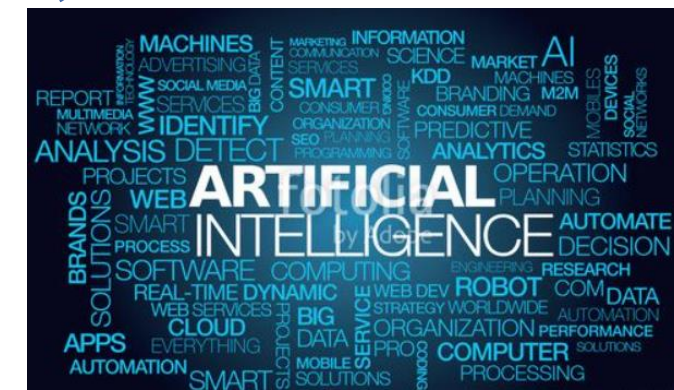
- **5V: Volume, Variety, Volocity, Veracity, Value**



- machine learning
- real-time stream analytics
- **government, industry, finance, manufacturing, healthcare, education, traffic**

Artificial Intelligence

- creation of intelligent machines and environments that work and react like humans
- programming for knowledge, reasoning, problem solving, perception, learning (including machine learning, deep learning), planning, ability to manipulate with different objects,
- from OCR and speech recognition to autonomous cars, social, general intelligence, brain interfaces,
- in healthcare, finance, military industry, automotive,
- technical and ethical challenges

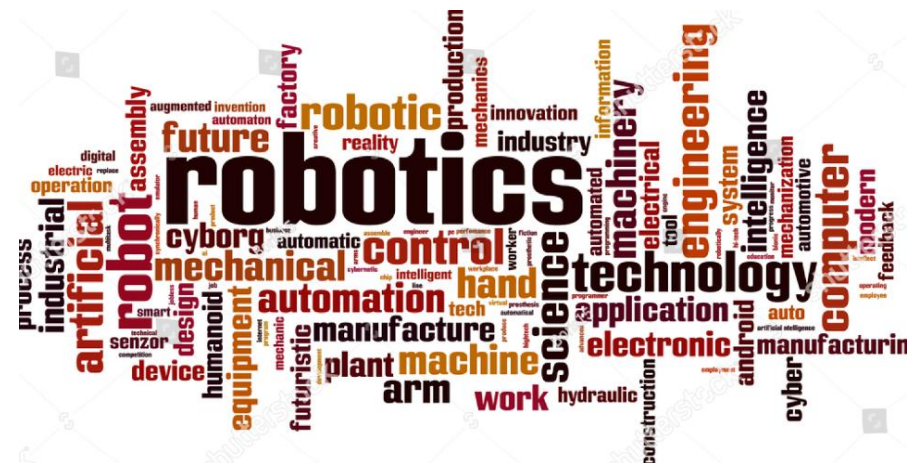


Robotics

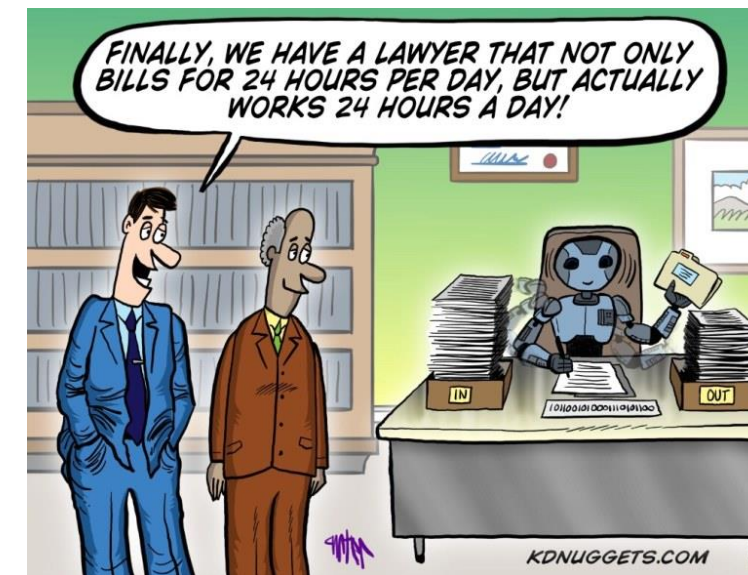
- interdisciplinary and includes mechanical engineering, electronic engineering, information engineering, computer science and others
- design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing
- applications in many areas



May 2019



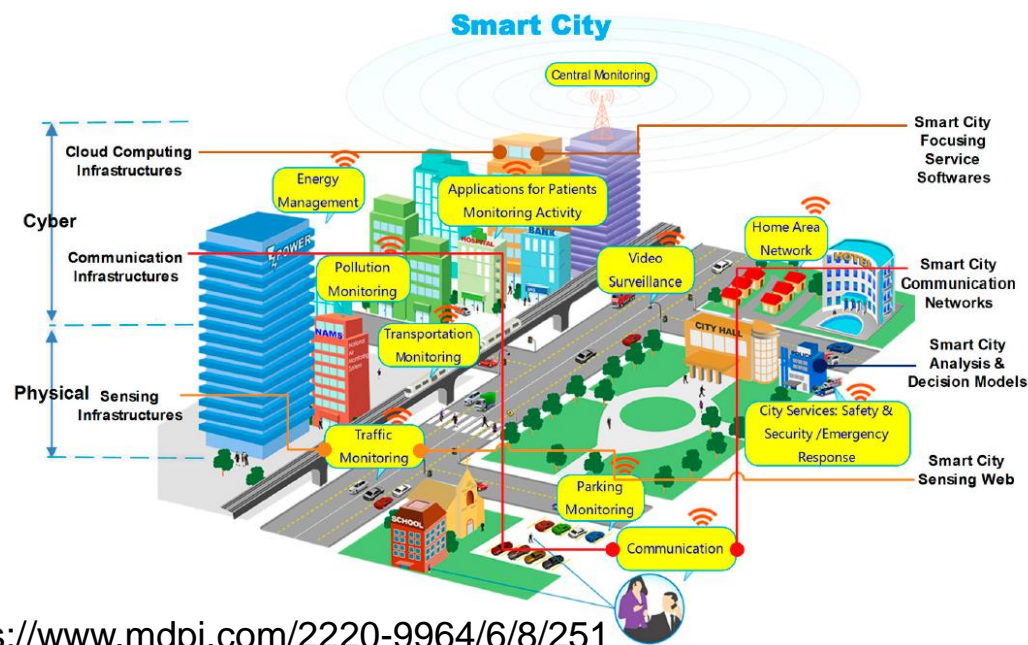
TeamSoc21 Workshop 2019 (Spain)



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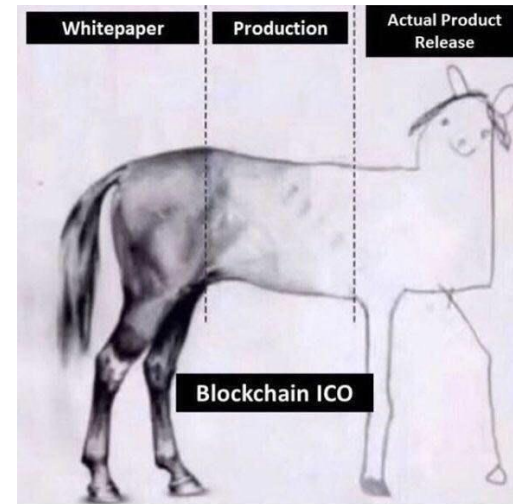
Cyber-Physical Systems and Industry 4.0

- complex engineered systems integrate physical, software and network aspects
- examples: smart grids, autonomous transportation systems, real-time traffic information, medical monitoring and rehabilitation, process control, automatic pilots in avionics,



Cyber-Security

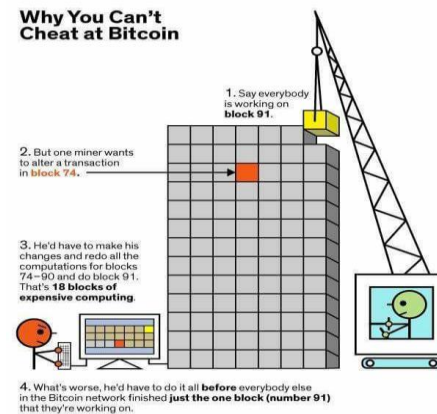
- technologies, processes, and practices designed to **protect networks, devices, programs, and data from attack, damage, or unauthorized access**
- need to coordinate its efforts throughout its entire information system (network, data, IoE, cloud, ...)



<https://www.cartoonistgroup.com/subject/The-Computer+Security-Comics-and-Cartoons-by-Lisa+Benson%27s+Editorial+Cartoons.php>
<http://cryptocoin123.com/1-crypto-comics-blockchain-ico-whitepaper-vs-production-vs-final-product/>

Blockchain

- growing list of records, called blocks, which are linked using cryptography
- decentralized, distributed and public digital ledger that is used to record transactions across many computers so that any involved record cannot be altered retroactively, without the alteration of all subsequent blocks
- healthcare, traffic, finance,



Quantum Computing

- „computers that exploit the **law of quantum physics** (physics that looks deep into the subatomic realm (protons, neutrons, ...) to explain the fundamental behaviour of universe”
- **qubits** (fundamental unit of information, trapped ions or superconducting device)
- extremely difficult task to pack a high number of qubits together (Google – 72, IBM – 50, Microsoft, Intel – close to achieving this)
- programming languages: Q#, QISKit, Cirq,
- applications: **machine learning, comp. chemistry, finance optimization, logistics/scheduling, drug design, cyber-security, fault simulation**

Quantum Computing



https://medium.com/@gowtham_palani/the-difficulty-with-quantum-computers-d0d5c5aed628

Answering to Main Challenges in ICT

The Skills Companies Want Now

- Business Process Improvement
- **Cloud Computing**
- Cross-functional Team Leadership
- **Data Analytics**
- **Distributed Systems**
- **Entertainment**
- **Finance**
- **Product and Program Management**
- **Programming Languages (from Python, Java, C/C++, C# to JavaScript, Kotlin, Swift, ...)**
- **Recruiting**
- **Supply Chain Management**
- **Software - all**

Horizon 2020 ICT Challenging Technologies

- A new generation of components and systems
- Advanced Computing
- Future Internet
- Content technologies and information management
- Robotics
- Micro- and nano-electronic technologies, Photonics
- Internet of Things/Everything, Innovation and Entrepreneurship Support
- Factories of the Future
- Cooperation-Cyber Infrastructures
- Cooperation-Communication Networks
- Research and Development Cooperation-5G, IoT

Biggest Issues ICT Faces Today

1. New Security Threats
2. Data Protection
3. Skills Gap
4. Multi-Cloud Security
5. Innovation and Digital Transformation
6. Finding New Revenue Stream
7. Lack of Agility
8. Outsourcing Risks
9. Bussines Results
10. Tools for a Digital Workforce
11. Rebuilding Trust

The Ten Best Programming Languages to Learn in 2019 (1)

1. Python
2. JavaScript
3. Rust
4. Go
5. Swift
6. Kotlin
7. C++
8. TypeScript
9. Java
10. F#

The Ten Best Programming Languages to Learn in 2019 (2)























1. Python
2. Java
3. C/C++
4. JavaScript
5. Go programming language
6. R
7. Swift
8. PHP
9. C#
10. MATLAB

Top programming languages to learn in 2019?

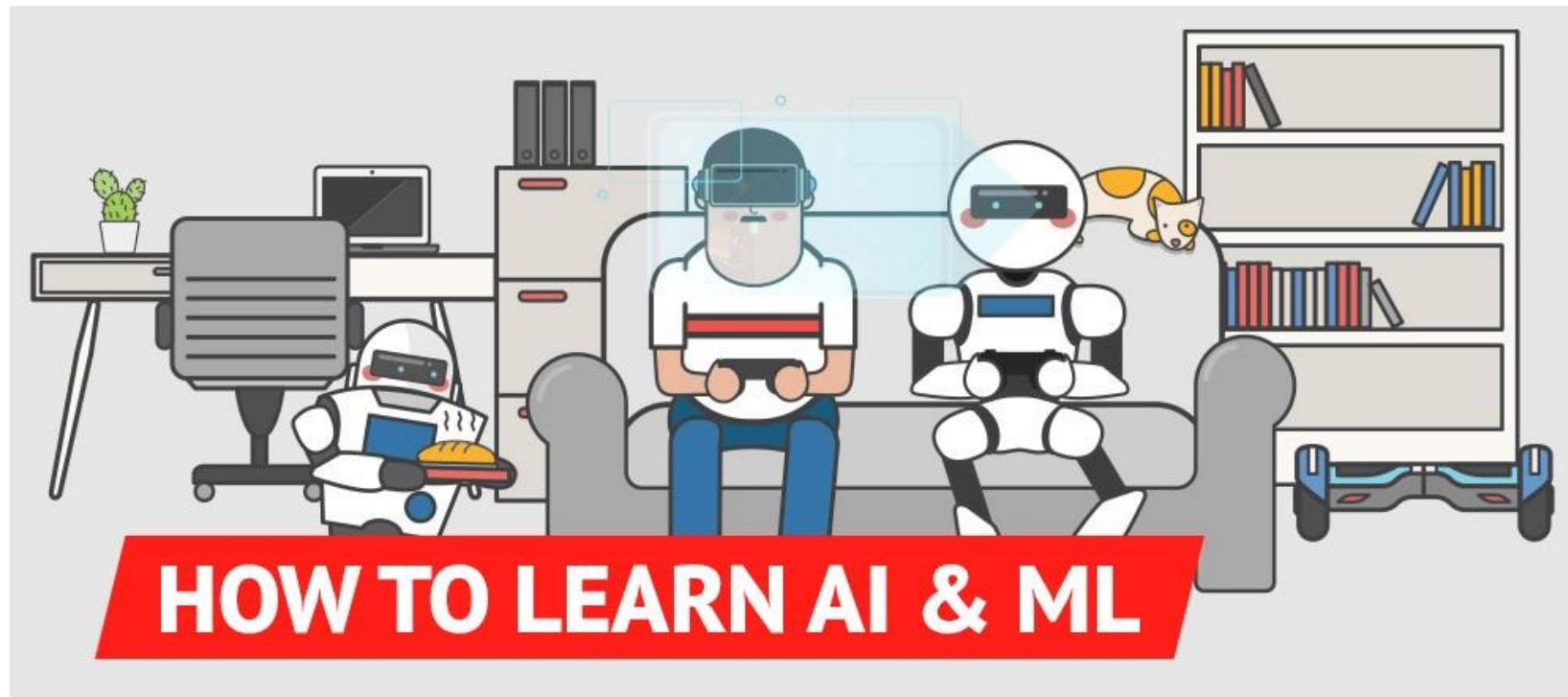
Developers name their favorites



IEEE Language Ranking 2018

Language Rank	Types	Spectrum Ranking
1. Python	  	100.0
2. C++	  	98.4
3. C	  	98.2
4. Java	  	97.5
5. C#	  	89.8
6. PHP		85.4
7. R		83.3
8. JavaScript	 	82.8
9. Go	 	76.7
10. Assembly		74.5

How to Learn...?



<https://hackernoon.com/16-best-resources-to-learn-ai-machine-learning-in-2019-f95c4f59018b?gi=ba4adc4a6b60>

Answering to Main Challenges in ICT – FERIT Osijek

FERIT Osijek, J.J. Strossmayer University of Osijek Science, Technology Transfer, Projects and Innovations

- **main research areas** (related to ICT): mathematical modeling, smart grids, advanced transport systems, image and video processing, intelligent control systems and robotics, AI, advanced communications systems, communications networks and next-generation network services, software systems, design, applications and software quality, real-time embedded computer systems, diagnostics and reliability, distributed and ubiquitous service-oriented computer systems, applied computational intelligence,
- **scientific/research projects** (HRZZ, Horizon,)
- **technology transfer**
- **patents**

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International Cooperation

- **partnership** with about 70 universities from Europe and world
- **cross-border cooperation** (INTERREG)
- **mobility** programmes (Erasmus+, Mundus – Euroweb+,)

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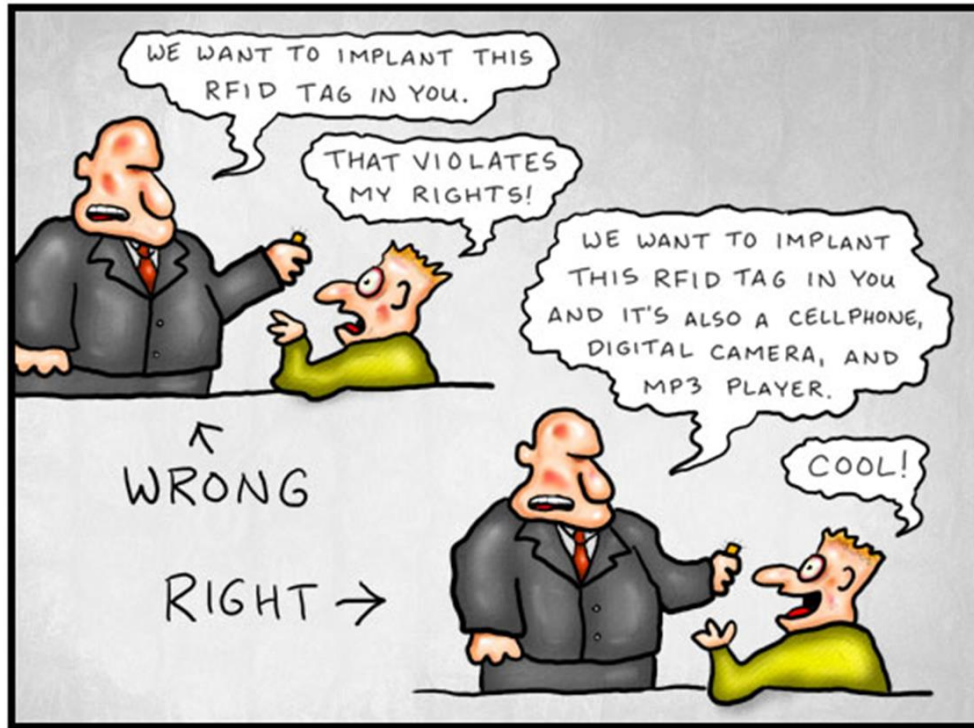


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Study Programmes

- **Undergraduate Study Programmes**
 - **Electrical Engineering (Bachelor of Electrical Engineering)**
 - **Computer Engineering (Bachelor of Computer Engineering)**
- **Graduate Study Programmes**
 - Electrical Engineering, branch: Power Engineering, blocks: Power Engineering Systems, Sustainable Power Engineering, Industrial Power Engineering
 - **Electrical Engineering, branch: Communications and Informatics, blocks: Communication Technologies, Network Technology**
 - **Computer Engineering, blocks: Computer Engineering, Robotics and AI, Software Engineering, Information and Data Science**
 - **Autoimotive Computing and Communcations**
(Master of Electrical Engineering/Computer Science)
- **Professional Study Programmes**
 - Electrical Engineering, branch: Power Engineering
 - **Electrical Engineering, branch: Automation**
 - **Computer Engineering**
- **Postgraduate Doctoral Study Programme in Electrical Engineering and Computer Science (PhD)**
 - branches: Power Engineering, **Communications and Informatics, Computer Science**
- **Postgarduate Specialist Study Programme in Electrical Engineering and Computer Engineering (Univ.Spec.)**
 - Power Enginnering in Electricity Market Environment
 - **Advanced Communication Technologies**
 - **Process Computing**

Startups in ICT, Ideas ?!?



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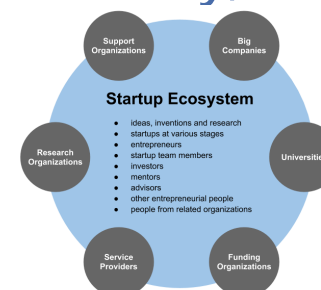
ICT Startup Ecosystem in Osijek

▪ FERIT Osijek

- about 2000 Students at all study levels (about 1500 students in ICT)

▪ J.J. Strossmayer University of Osijek

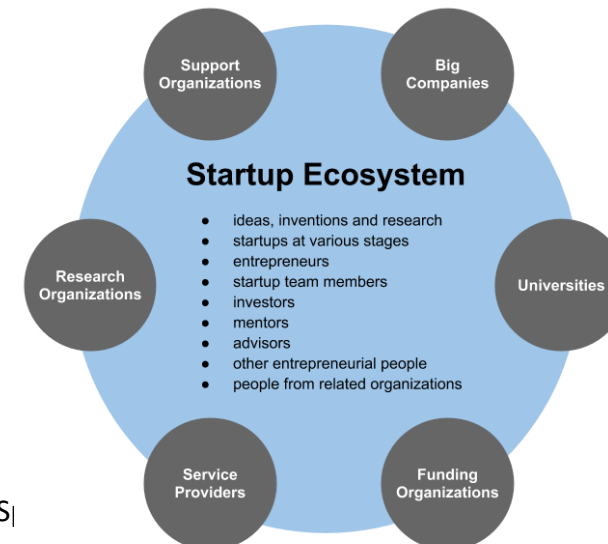
- 17 Faculties, Departments, Academy of Arts and Culture, 8 Centres and 2 Companies
- about 18000 Students
- TERA Technopolis d.o.o. (Technology – Development Centre: J.J. Strossmayer University of Osijek, Osijek-Baranja County, City of Osijek)



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ICT Startup Ecosystem in Osijek

- Business Incubator BIOS d.o.o.
 - currently over 40 companies and startups
- Osijek Software City
 - currently about 45 companies or startups and about 75 persons – members
- Business Incubators in the Area
- Business Zones in the Area



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ICT Startup Ecosystem in Osijek

- about 60 ICT companies and/or startups
- these companies practically cover all mentioned ICT areas, challenges, architectures, development tools, frameworks and programming languages
- more than 70% of employees are former or current students of FERIT Osijek

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ICT Startup Ecosystem in Osijek

- **main areas of activity** of ICT companies (1):

- web development (incl. on-line shops, social networks, digital marketing, web optimization, agile development)
- mobile development (incl. Android and IOS, uX, agile development)
- cloud-based services (incl. pharmacy, health, finance)
- big data, data analysis, machine learning, BI, risk analysis and scoring
- software solutions for business and financial sector and enterprises (incl. B2B solutions, banks, capital, ERP (Enterprise Resources Planning), telecommunications)

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ICT Startup Ecosystem in Osijek

- **main areas of activity** of ICT companies (2):

- embedded systems, IoT and real-time and cyber-physical systems development
- automotive and intelligent transportation systems
- software testing
- autonomous technologies and robots
- e-commerce applications, digital marketing
- network technologies and services, 5G
- computer graphics, design and multimedia

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and ICT Startup Ecosystem in Osijek

- **main areas of activity** of ICT companies (3):

- TV software
- game development
- blockchain
- ICT for agriculture and farms, food industry, company resource management, health
- GIS
- consultancy in ICT and business

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ICT Startup Ecosystem in Osijek

- some **former startups** and companies in Osijek were in the area of:
 - cloud-based dairy herd & farm business management software (Farmeron)
 - Wi-Fi in crisis situations – MeshPoint -> (Crisis Innovation Lab)
-
- according to [Startupblink](#) **new startups** in Osijek are in the area of:
 - sales automation
 - enterprise software
 - cloud computing
 - many more,

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ICT Startup Ecosystem in Osijek

- some other **new startups and companies** in Osijek are in the area of:
 - AI and logistics robots (Gideon Brothers)
 - game development (Void Main Studio)
 -
- unsuccessful stories are also possible, but it's not the end – it's (new) beginning
- mentorship and financing are important (family members, some other or [AngelList](#))

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ICT Startup Ecosystem in Osijek

- some bigger ICT companies in Osijek and area:

- Ericsson Nikola Tesla (Osijek centre)
- RT-RK Osijek (co-founded with FERIT Osijek)
- Span d.o.o.
- Mono d.o.o.
- Atos Convergence Creators
-

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ICT Startup Ecosystem in Osijek

- FERIT Osijek permanently cooperate, communicate and work together with ICT companies, startups and all other subjects of ICT and startup ecosystem through the following activities:
 - adjustments and improvements of study programmes and other educational activities (final papers, master thesis, practical training, guest lectures) in pace with labour market
 - technology transfer, research, innovations, research projects
 - professional work and projects
 - support to new ICT companies interested to work in Osijek and wide area
 - organization of events
 - all other activities

Key takeaways

Key takeaways – Technical aspect

- Companies and Startups
 - Text1
 - Text2
- FERIT Osijek - University
 - Text1
 - Text2

Key takeaways – Societal aspect

- Companies and Startups
 - Text1
 - Text2
- FERIT Osijek - University
 - Text1
 - Text2
- Local and Global Society
 - Text1
 - Text2

Key takeaways – Business aspect

- Companies and Startups
 - Text1
 - Text2
- FERIT Osijek - University
 - Text1
 - Text2
- Local and Global Society
 - Text1
 - Text2



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