Master ICT for Internet and multimedia engineering

Presentation May 27, 2020 will start at 16:30
Ingegneria delle Telecomunicazioni

ICT for Internet and Multimedia
Do you just “transport” information?

Some will tell you that studying ICT just means becoming a “carrier” of information.
How much is “transport” worth?

MARKET CAPITALIZATION OF ZOOM VS. TOP AIRLINES

<table>
<thead>
<tr>
<th>Airline</th>
<th>Market Capitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoom Communications</td>
<td>$48.78B</td>
</tr>
<tr>
<td>Southwest</td>
<td>$14.04B</td>
</tr>
<tr>
<td>Delta</td>
<td>$12.30B</td>
</tr>
<tr>
<td>United</td>
<td>$5.87B</td>
</tr>
<tr>
<td>IAG</td>
<td>$4.11B</td>
</tr>
<tr>
<td>Lufthansa</td>
<td>$3.87B</td>
</tr>
<tr>
<td>American Airlines</td>
<td>$3.89B</td>
</tr>
<tr>
<td>Air France KLM</td>
<td>$2.14B</td>
</tr>
</tbody>
</table>

Total Airlines: $46.21B

Source: YCharts, as of May 15, 2020. Top airlines are selected based on their 2019 revenue. Concept inspired by Lennart Dobravsky at Lufthansa Innovation Hub.
Overview
What is ICT?

- Acronym of Information and Communication Technology = systems (both hardware and software) for transmitting, sharing, and processing information
Why **Internet** and **multimedia**?

**Internet**
is the biggest and most widely used telecommunication system in the entire planet

Nowadays \( \sim 50\% \) world population is connected \( \rightarrow \) still wide margins for growth
Why Internet and multimedia?

- **Multimedia** = multiple information sources
- Also multiple ways to communicate (Text, Video, Audio, Augmented reality...)
- The majority of Internet traffic is multimedia!
ICT: cornerstone of the Digital Era

- Computer Science
- Networks
- Digital devices
- Signals & Data
- Life Science
- eHealth
- Electrical Engineering
Communications route

Classical and revolutionary transmission techniques
Communications

5G networks
broadband, low latency connectivity
*access through stations:* Cellular, mmWave

Massive MIMO
really many transmitting units
*access through stations:* Antennas, Inf. Theory

Acoustic communications
marine monitoring and networking
*access through station:* Underwater
Software applications through the entire protocol stack
Mathematical models understanding and designing the Internet

access through station: Maths

Cognitive and Software-defined intelligence brought in the interconnection

access through stations: Networks, Game Theory

Smart cities ubiquitous networking for public services

access through station: Internet of Things
Multimedia route

Multidimensional contents for data-hungry systems
Multimedia route

Immersive reality
Delivering a full multimedia experience
access through station: 3D

Digital perception
Eyes, ears, brains of robots or autonomous cars
access through station: Computer vision

Medical signal processing
Advanced diagnosis and treatment
access through station: Imaging
Systematic ways to extract knowledge from data
Distributed data management
Querying the cloud from everywhere
*access through station*: Web

Biometrics
The human body as the sensing field
*access through station*: Human data

Deep learning
Unsupervised artificial intelligence
*access through station*: Machine learning
Quality of life route

IT expertise for medical care and mHealth scenarios
Quality of life route

Digital health
Real-time communication for medical apps
*access through station*: Telemedicine

Brain computer interfaces
Neural training against degeneration
*access through*: Neuroscience, Rehabilitation

Molecular photonics
Non-invasive monitoring and diagnostics
*access through station*: Bio-EM
Nanotechnologies route

Reach nanoscale to communicate at the speed of light
Nanotechnologies route

Photonic sensing
Monitoring through dielectric coupling
access through station: Fiber optics

Renewable energies
Smart exploitation of natural energy sources
access through station: Green

Plasmonics
Electron/photon coupling to go beyond \( \lambda \)
access through station: Photonics
Ensure privacy and data protection for cybersecurity systems.
Secure satellite positioning
Preventing localization and navigation forging
*access through station*: GNSS

Digital crime fighting
Detecting false media and documents
*access through station*: Forensics

Quantum cryptography
Ultimate security through quantum physics
*access through station*: Quantum
To sum up

- **Innovative scientific topics** at the edge of new research horizons
- **Matching all tastes** from highly mathematical to applied and hands-on
- **Interconnecting disciplines** with a planned path (we don’t just do “a bunch of cool stuff”)

International priority
Travel is fatal to prejudice, bigotry, and narrow-mindedness, and many of our people need it sorely on these accounts.

Mark Twain
Fully taught in English

• No English test required beforehand
• But you must understand (basic) English
Incoming students

• **ICT for Internet and Multimedia** is one of the largest International Masters @ UniPD

• So far: 83 international students admitted

• applications are still ongoing
Erasmus+

# destinations

<table>
<thead>
<tr>
<th>Country</th>
<th>Count</th>
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</thead>
<tbody>
<tr>
<td>France</td>
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<tr>
<td>UK</td>
<td>2</td>
</tr>
<tr>
<td>Norway</td>
<td>1</td>
</tr>
<tr>
<td>Germany</td>
<td>3</td>
</tr>
<tr>
<td>Ireland</td>
<td>1</td>
</tr>
<tr>
<td>Austria</td>
<td>1</td>
</tr>
<tr>
<td>Portugal</td>
<td>2</td>
</tr>
<tr>
<td>Sweden</td>
<td>2</td>
</tr>
<tr>
<td>Denmark</td>
<td>1</td>
</tr>
<tr>
<td>Serbia</td>
<td>1</td>
</tr>
<tr>
<td>Italy</td>
<td>1</td>
</tr>
<tr>
<td>Spain</td>
<td>8 (incl. Canary)</td>
</tr>
</tbody>
</table>

and counting...
Double degrees

International agreements of Double Degree with top-ranked universities worldwide:

• National Taiwan University (2 positions)
• Universidad Politecnica de Madrid (2 positions)
• more agreements (France, Finland) in preparation

Compared to similar programs (e.g., TIME) you still get 2 degrees, but in ~2 years, not 3
DD: how does it work?

• Apply halfway through 1\textsuperscript{st} year → must earn 60 ECTS in Padova by September
• If selected, spend the 2\textsuperscript{nd} year abroad
• Final thesis done and discussed abroad before a joint committee, also valid for Italian degree
• Supporting scholarship (more than Erasmus) for a period = min(gradient, 24 months)
Job market
Yes, everything looks cool, still... will I find a job (and a good one) afterwards? Are "classical" degrees better for the job market?

IMPRESSIVE. MOST IMPRESSIVE.

BUT WHAT ABOUT JOB PROSPECTS?
A double track for the job market

Enterprises working on ICT
from hardware to software, access/transport/application

Enterprises working using ICT
networking, data analytics, security, energy efficiency
Job market

Local and global enterprises

Abroad for education or work

R&D at universities or research centers

Internship options
Monthly salary after 1 year
Graduates of 2018

source: XXI survey
Employment rate after 1 year

Graduates of 2018

source: XXI survey
Satisfaction rate about the program
( yes = light, no = dark)
Graduates of 2019

source: XXI survey
Satisfaction rate about the lecturers
( yes = light, no = dark)
Graduates of 2019

source: XXI survey
How is the teaching load?
(light or heavy = dark)
Graduates of 2019

(source: XXI survey)
Would you choose it again?

Graduates of 2019

source: XXI survey
Other data

• Average duration of studies: 2.5 years (also includes Double Degree students)
• Average graduation mark: 108.5
• Had an experience abroad: 51% (note: another ~30% are foreign nationals)
• Average time from graduation to 1st job: 1.3 months

source: XXI survey
MIME is a 2-year (120 ECTS credits) postgraduate course. In the Italian system, it is a “Laurea Magistrale” of class LM-27.
Admission

Holders of Italian degree ≥ 84/110 with at least 50 ECTS credits in:
• maths (MAT/02, MAT/03, MAT/05, MAT/06)
• physics (FIS/01)
• computer science (INF/01, ING-INF/05)
• telecommunications (ING-INF/02, ING-INF/03)

**Direct access** for graduates with a Bachelor degree in Information Engineering, Maths, Physics, Computer Science

Guaranteed for all BS degrees of DEI, DM, DFA @ UniPD
- and easily for students of other universities or degrees
- foreign candidates have their own evaluation track
Foundations

Recommended background in
• Signals and systems
• Probability and statistics
• Telecommunications

If in doubt about it → contact the teaching committee

You can fill gaps even after enrolling

**No English certificate required,** but you need to prove/declare that you understand it
So if you have a certification, even better
- there is an English test within the program, anyway
Enrolment steps

1: Pre-enrolment
on uniweb.unipd.it (soon)

2: Career evaluation
on uniweb.unipd.it/valutazionetitoli
(actually another website!) – all students must do it!
You must perform BOTH - you can do 2 just after 1.
After receiving confirmation of that your career is ok:

3: Enrollment – also on uniweb.unipd.it
Study plan: what we offer

Exams of different sizes
Mandatory exams
“Serial” courses

All courses = 6 credits
Highest freedom of choice
“Open” courses
Common characteristics

Flexible

• Without mandatory exams
• All the exams are of 6 ECTS credits: just choose the preferred disciplines that fit you the most
• 12 ETCS credits (2 exams) are “fully elective” → you can take previously discarded subjects or even exams from another curriculum or degree
Common characteristics

Professional

• Final MS thesis project of 30 ECTS covering your last semester (including internship or research activity)
• 6 credits for “soft skills”
  • 3 for English B2 level
  • 3 for short courses on project management, public speaking in English or more
Typical study plan

1\textsuperscript{st} semester
- 12 curriculum-specific “integrated course”
- 18 exams

2\textsuperscript{nd} semester
- 30 exams

3\textsuperscript{rd} semester
- 24 exams
- 6 soft skills

4\textsuperscript{th} semester
- internship
- MS thesis

flexible!

Erasmus
Four areas of specialty = 4 curricula
Teaching committee

When in doubt about choices of curriculum or exams, ask the teaching committee!
You can reach them at mime@dei.unipd.it

You can also ask them how to handle Erasmus+ exchanges or recognition of past extra activity!
Motivation
Explore all layers from PHY to APP
ICT is the main enabler of Industry 4.0

Scenarios
Next generation wireless, antenna design, sensors
network optimization, security, multimedia, R&D
Telecommunications

**Telecommunication principles**
- Wireless communications
- Programming for telecom

**MANDATORY**

- 5G systems
- Antennas
- Communication network design
- Computer vision
- Digital communications
- Digital signal processing
- Fiber optics
- Information theory
- Internet
- IoT and smart cities
- Machine learning
- Multimedia coding
- Optical and quantum communications
- Optical networks

**CHOOSE 2 FROM**
- Convex optimization
- Digital innovation and society
- High level programming
- Laboratory of big data analytics
- Programmable hardware devices
- Quantum information and computing

**CHOOSE 1 SOFT SKILL**
- Project management
- Public speaking
- Public values in media and ICT

**CAN ALSO CHOOSE FROM**
- Comp.eng. for music and multimedia
- Game theory
- Information security
- Physics data analysis
- Stochastic processes
Internships at ...

**ARRI**
MÜNCHEN (DE)
- Signal processing for digital cinema

**Fiat Chrysler Automobiles**
TURIN / USA
- 5G vehicular communications

**Huawei**
MILAN / CHINA
- Cellular networks R&D

**Wind Tre**
VENICE
- National telco operator

**World Sensing**
BARCELONA (ES)
- Wireless sensors monitoring

**RFI**
MESTRE (VE)
- Railway network

**Telenor**
OSLO (NO)
- National telco operator

**CAME SpA**
DOSSON DI CASIER (TV)
- Safe access

**Gavia systems**
ROVIGO
- Public WiFi services

**Bft Spa**
SCHIO (VI)
- Domotic and automation
Is it a good choice for me?

Strong **mathematical** background is needed
- especially in probability and signal theory

Many courses are **project**-oriented
- be careful not to pick too demanding tasks

Mostly focuses on **telecommunications**
- did you like your “fundamentals” course?
Motivation

System interconnection opens up new horizons, inspiring challenges... and amazing job opportunities!

Scenarios

The third platform: Social, Mobile, Analytics, Cloud, Automotive, Tactile Internet, WWW, Blockchain
Cybersystems

MANDATORY
Network systems
  = Network science
  + Internet
Foundations of databases

CHOOSE 2 FROM
Big data computing
Convex optimization
Cryptography
High level programming
Laboratory of big data analytics
Learning from networks
Web applications

CHOOSE 1 SOFT SKILL
Project management
Public speaking
Public values in media and ICT

CHOOSE 6 FROM
3D augmented reality
Communication network design
Computer vision
Digital forensics
Digital signal processing
Game theory
Information theory
IoT and smart cities
Information security
IoT and smart cities
Machine learning
Network analysis and simulation
Network coding
Stochastic processes
Wireless communications

CAN ALSO CHOOSE
Information theory
IoT and smart cities
Life data epidemiology
Natural language processing
Neural networks and deep learning
Network systems and dynamics
<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
<th>Specializations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanmarco Informatica</td>
<td>GRISIGNANO DI ZOCCO (VI)</td>
<td>IT Solutions</td>
</tr>
<tr>
<td>Teypra SRL</td>
<td>ROVIGO</td>
<td>IoT connected devices</td>
</tr>
<tr>
<td>Sony Eutec</td>
<td>STUTTGART (DE)</td>
<td>Multimedia R&amp;D</td>
</tr>
<tr>
<td>Mida Solutions</td>
<td>PADOVA</td>
<td>Voice &amp; data app virtualization</td>
</tr>
<tr>
<td>Ugido</td>
<td>PADOVA</td>
<td>IoT / Blockchain Software eng.</td>
</tr>
<tr>
<td>Aquifi</td>
<td>PALO ALTO (US)</td>
<td>3D vision</td>
</tr>
<tr>
<td>solidThinking</td>
<td>VICENZA / USA</td>
<td>3D rendering</td>
</tr>
<tr>
<td>Nokia Bell Labs</td>
<td>DUBLIN (IR)</td>
<td>Low power networking</td>
</tr>
<tr>
<td>Altran Italia</td>
<td>ROME</td>
<td>5G, video 3D, cybersecurity</td>
</tr>
<tr>
<td>Athonet Vicentino</td>
<td>BOLZANO VICENTINO (VI)</td>
<td>Software defined networking</td>
</tr>
</tbody>
</table>
Is it a good choice for me?

A mixture of math, computer science, telecom
• you certainly need good programming skills

A system-wide perspective, with an eye on cross-disciplinary topics, and an open mindset
**Photonics**

**Motivation**
Photonics and light-based technologies are drivers of this century’s industry.

**Scenarios**
Hyperspectral analysis, earthquake monitoring, optical neurosynaptic networks, quantum computers.
Photonic technologies
  = Fiber optics
  + Photonic devices
Molecular photonics

CHOOSE 6 FROM
  Antennas
  Biophotonics
  Digital communications
  Digital signal processing
  Internet
  Machine learning
  Nanophotonics
  Optical and quantum communications
  Optical networks
  Quantum cryptography and security
  Wireless communications

CHOOSE 2 FROM
  Nanostructured materials
  Optoelectronics for green
  Photovoltaic science and technology
  Programmable hardware devices
  Quantum information and computing
  Quantum optics and laser

CHOOSE 1 SOFT SKILL
  Project management
  Public speaking
  Public values in media and ICT

CAN ALSO CHOOSE
  5G systems
  Convex optimization
  Economic policy and local development
  High level programming
  Information theory
  Laboratory of big data analytics
  Physics data analysis
Internships at ...

**Leonardo**
CARSOLI (AQ)

Thin films for space optics

**Qascom**
BASSANO DEL GRAPPA (VI)

Secure satellite communications

**DeltaOhm**
PADOVA

Photo radiometric sensors

**CEIT**
MONSELICE (PD) / SVIZZERA

Fiber optical networks

**NTSG**
ROMA

Fiber sensing and monitoring

**Calearo Antenne**
ISOLA VICENTINA (VI)

Antennas for 5G and automotive

**Infineon**
PADOVA / AUSTRIA

Semiconductors and IoT

**Adant**
PADOVA

Reconfigurable antennas

**SIT**
PADOVA

Measurement for safety

**Nidek Medical**
ALBIGNASEGO (PD) / GIAPPONE

Optometrical instrumentation
Is it a good choice for me?

Your proficiency in **physics** will be put to the test
• electromagnetism, quantum, physics of matter

But you need a very **engineering** attitude
• laboratory activity is really important here

(yes, this is our **real lab** and not a stock picture)
Life & Health

Motivation
ICT improves well-being with pervasive monitoring, prevention/cure, rehabilitation

Scenarios
Neuroscience, augmented reality, genomics, stroke/accident prevention, healthy ageing, sport, wearable sensors, everyday life
# Life & Health

**MANDATORY**
- Digital processing for life and health
  - Digital signal processing
  - Machine learning

**CHOOSE 3 FROM**
- Clinical engineering and health tech
- Computational genomics
- Human electrophysiology
- Molecular photonics
- Neuroimaging techniques
- Neurorehabilitation and BCI
- Quantitative life science
- Sports engineering and rehab

**CHOOSE 1 SOFT SKILL**
- Project management
- Public speaking
- Public values in media and ICT

**CHOOSE 6 FROM**
- 3D augmented reality
- Biometrics
- Biophotonics
- Computer vision
- Digital forensics
- E-health
- Human data analytics
- Internet
- Life data epidemiology
- Multimedia coding
- Network science
- Neural networks and deep learning

**CAN ALSO CHOOSE**
- Clinical neuropsychology
- Economic policy and local development
- Foundation of databases
- High level programming
- Human computer interaction
- Laboratory of big data analytics
- Learning from networks
### Internships at...

<table>
<thead>
<tr>
<th>Malvestio</th>
<th>Khymeia</th>
<th>Policlinico</th>
<th>BrainTrends</th>
<th>Phoenix RTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>VILLANOVA DI CAMPOSAMPIERO (PD)</td>
<td>NOVENTA PADOVANA (PD)</td>
<td>Sant’Orsola BOLOGNA</td>
<td>ROMA</td>
<td>PADOVA</td>
</tr>
<tr>
<td>Sensors for hospital bed</td>
<td>Virtual reality for neurorehab</td>
<td>Infectious diseases unit</td>
<td>Brain biosignal sensing</td>
<td>Hyperspectral for agrifood</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AMPED</th>
<th>Nidek Medical</th>
<th>Inst. Behavioral Neurobiology</th>
<th>WYSS Center</th>
<th>Inst. Tecnologico de Canarias</th>
</tr>
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<tbody>
<tr>
<td>TRIESTE</td>
<td>ALBIGNASEGO (PD) / GIAPPONE</td>
<td>Neurobiology TUBINGEN (D)</td>
<td>ZURICH (CH)</td>
<td>CANARY ISLANDS (E)</td>
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<tr>
<td>Forensics multimedia</td>
<td>Ophtalmology ocular diagnosis</td>
<td>Paralysis/stroke monitoring</td>
<td>FMRI-BCI analysis, Neuroprosthetics</td>
<td>CAD for bone reconstruction</td>
</tr>
</tbody>
</table>
Is it a good choice for me?

Requires interest in both ICT & medical subjects
• you must acquire solid skills in both areas; thus, also math, computer science, telecommunications
• a rigorous engineering program

Note that you will not find:
• general courses in chemistry or physiology
• courses of biology, biomechanics, biomaterials
After the degree: PhD?

About 1 in 4 of our MSc graduates pursue higher education towards a PhD.

Our department offers a highly qualified PhD program in Information Engineering.

Graduates in the last 10 yrs from our MSc+PhD are now:

- Professors/academic researchers at: Purdue, Irvine, UC3M Madrid, Malaysia Pahang, New York Univ, Univ. Firenze, Michigan, Porto, San Diego, Kentucky, Dresden, Aalborg, Rochester, Norce Bergen Norway

- Industrial project engineers at: Gameloft, Nokia, Ublox, TIM, Qascom, SIAV, Aquifi, Ceam, Mount Sinai Hospitals NY, Wind-tre, McKinsey, Urbana Smart, ElettronicaBiomedicale, DLR, Calearo Antenne, ESA, Cisco, Microsoft, Athonet
A scholarship/award assigned to promising students to help them pursue the degree in “ICT for Internet and multimedia”

Based on:
  i. academic track record;
  ii. interview with the Evaluation Committee

2 awarded prizes of 5000 euros each

The call will be out soon: check the website www.unipd.it/borse-premi-studio-studenti
Questions
Contacts

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Slides available at:
/mime.unipd