

IN5410/IN9410 “Energy Informatics”

course information



Lectures will be given by

- 3 Professors from IFI@UiO, OsloMet
- 1 Teaching assistant
- 2 external/international professors
- 10 Industry experts

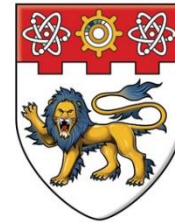


UNIVERSITY OF
TORONTO



Myself – Yan Zhang

- *Professor*, Department of Informatics, University of Oslo, Norway
- *PhD*, Nanyang Technological University, Singapore



NANYANG
TECHNOLOGICAL
UNIVERSITY

Previously,

- *Head of Department / Chief Scientist*, Simula Research Laboratory, Norway

[**simula** . research laboratory]

Frank Eliassen

- ***Professor, Department of Informatics,
University of Oslo, Norway***



Previously

- ***Research Director, Simula Research Laboratory,
Norway***



[**simula** . research laboratory]

- ***Professor, University of Tromsø, Norway***



Sabita Maharjan

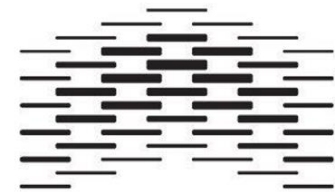
- *Senior Research Scientist, Oslo Metropolitan University (OsloMet)*
- *Associate Professor, Department of Informatics, University of Oslo, Norway*



Previously

- *Senior Research Scientist, Simula Research Laboratory, Norway*

[**simula** . research laboratory]



OSLO
METROPOLITAN
UNIVERSITY

Hwei Ming Chung – teaching assistant

- *PhD student*, Department of Informatics, University of Oslo, Norway
- Office: 5163

Previously

- *Master student*, National Sun Yat-sen University, Taiwan
- *Visiting student*, Telecom SudParis, France
- *Visiting student*, Singapore University of Technology and Design, Singapore



Goal

Exploit ICT (Information & Communications Technologies) to tackle the global warming and climate change challenges

Teaching

- Invited speakers from industry and international universities
- Learn both concepts & principles and practices
- Learn computer techniques for future energy systems
- Learn through assignments, programming and real datasets

Lectures

- Time: 09:15-12:00, Thursday
- Seminar room:
 - Shell
- Totally 12 lectures
- Course materials: no books since the topic is very new. We will put the material in the course webpage Monday or Tuesday in the week when we will give the lecture.
- **Note:** No lecture on 28 February

“Energy Informatics” is NOT about the traditional concepts

Energy



Informatics



“Energy Informatics” focuses on state-of-the-art computer science for sustainable future energy systems

Energy



Informatics



What are we teaching?

- The scope of energy informatics includes
 - state-of-the-art computer science and engineering
 - and their applications for sustainable energy sectors
 - Here, energy sectors include: smart grid, electric vehicles, wind power, data center
- This course lays the foundation to understand
 - where and how computer engineering apply in the energy systems
 - knowledge and skills can be easily extended to solve problems in other systems, e.g., Norway Oil Fund, bank, transport, insurance, financial

Job market is one major motivation



21. des 2016 Oslo

Spennende arbeid med sikkerhet innen IKT!

Leder for Security Operation Center (SOC)

Statnett SF Systemskift

1 stilling



16. des 2016 Trondheim

Principal Cloud Architect

Principal Cloud Arcitect

Powel AS

1 stilling



16. des 2016 Trondheim

Chief Data Scientist

Powel AS

1 stilling



Norges største nettselskap?

Sikkerhetsrådgiver IKT

Hafslund Nett AS

1 stilling

Job market is not limited to energy sectors



Ny i dag Oslo

DNB ITOP Forretningsstøtte, seksjon Business Control

Data Analyst (Modellerings-/systemressurs)

DNB Bank ASA ITOP Forretningsstøtte

1 stilling

9. jan 2017 Fornebu



Senior Data Scientist - Customer Lifetime Value & Revenue development

Telenor - Telenor Norge AS

1 stilling

3. jan 2017 Oslo

Lyst til å jobbe som utvikler og/eller arkitekt av Big-data løsninger for større virksomheter?

Utviklere og arkitekter Big-Data og IoT

Capgemini Norge AS

3 stillinger



UiO : Universitetet i Oslo

4 PhD fellowship on energy informatics

Market for summer job/internship

- <https://statnett.easycruit.com/vacancy/2211367/175375>

Statnett



Lyst til å bruke sommeren på et morsomt og meningsfullt prosjekt?

Sommerprosjektet KUBE

Fylke:

Oslo

Feil i strømnettet kan føre til strømbrudd som er veldig kjedelig for deg og meg, og veldig dyrt for samfunnet. I årets KUBE-prosjekt, ønsker vi å utfordre seks studenter til å levere ny funksjonalitet til Statnetts løsning for automatisk analyse av feil i strømnettet; AutoDig. Teamet vil jobbe med utvikling, testing, interaksjonsdesign, dataanalyse og elkraftfaglig ingeniørarbeid. Dere vil arbeide tett opp mot det anerkjente DevOps-teamet som utvikler og drifter AutoDig. AutoDig håndterer data i sanntid fra vår data lake, og brukes i den operative styringen av kraftsystemet. Utstrakt sensorbruk og maskinlæring er viktig i løsningen. Tekniske ressurser vil bistå dere gjennom sommeren og gi nødvendig opplæring. Eksempler på språk og teknologier dere kan få bruk for er Python, Java, Angular JS, Git og SQL.

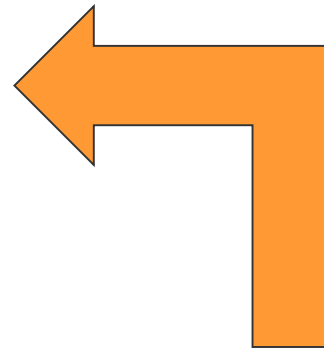
Motivations – in general

- **Observation:**
 - Energy sector is extremely important for Norway and the globe.
 - Energy sector is facing the two challenges: 1) applying state-of-the-art ICT knowledge; 2) short of young talents
- **Urgent need:** the graduates who have good knowledge of ICT and good understanding on how to apply computer techniques in real applications (e.g., energy, bank, insurance, transport etc)
- **Job market:** demonstrated by a large number of ICT jobs in the energy sector and other sectors, e.g., Statnett, Powel, Hafslund, Data center

Our teaching topics

Energy Areas

- Smart Grid
- Energy Market
- Demand Response
- Electric Vehicles
- Vehicle-to-Grid (V2G)
- Renewable Energy Forecasting



**Computer science
tackles energy issues**

Informatics

- Cloud/Fog Computing
- Green Data Center
- Game Theory
- Internet of Things, Blockchain
- Cyber Security
- Machine Learning, Deep Learning
- Time-series Data Analysis

Teaching Plan (Spring 2019)

Lecture #	Date	Topic	Given by
1	17.01	Power Market: The Green revolution and the role of ICT Introduction to the course	Jan Bråten Yan Zhang
2	24.01	Energy Informatics: overview Renewable Energy Basics	Yan Zhang Øystein Ulleberg
3	31.01	Demand Response: industry perspective Demand Response	Kari Dalen Yan Zhang
4	07.02	Energy Market and Nord Pool Energy Market and Game Theory	Vivi Mathiesen Sabita Maharjan
5	14.02	Green Data Center Green Mountain: industry	Sabita Maharjan Tor Kristian Gyland
6	21.02	Cloud/Fog Computing for Smart Grid Robot and Digitalization for Automatic and Real-time Power Grid	Sabita Maharjan Ylvisåker Hans Terje
7	07.03	Smart Grid Privacy and Security Smart Grid Cyber-Security: industry perspective	Yan Zhang Jon Andreas Pretorius
8	14.03	TESLA as Internet of Things (Electric Vehicles, Blockchain) Blockchain Technology and its Application in Energy Systems	Yan Zhang Arne Øvrebø Lie
9	21.03	Machine Learning for Renewable Energy Forecasting Wind Energy Forecasting: industry perspective	Yan Zhang Arne Gravdahl
10	28.03	Deep Learning for Energy Forecasting Machine Learning Applications for Intelligent Energy Systems	Yan Zhang Boris Tistan
11	04.04	Machine Learning for Time Series Data Analysis in Smart Grid	Yan Zhang
12	11.04	Research Directions in Energy Informatics	Hans-Arno Jacobsen

Invited World-class Scientists

- Øystein Ulleberg, *Principal Scientist / Forskningsleder, Institute for Energy Technology (IFE); Associate Professor, University of Oslo*
 - Renewable Energy Basics
- Hans-Arno Jacobsen, *Professor, University of Toronto, and Technical University of Munich, Germany*
 - Research Directions in Energy Informatics



Invited Industry Experts

Statnett



DNV·GL



**Green
Mountain**

Hafslund 

windsim

 **BKK**

Invited Industry Experts (I)

- Jan Bråten, *Chief Economist / Sjeføkonom, Statnett*
 - Power Market: The Green energy revolution and the role of ICT
- Kari Dalen, *Seniorrådgiver, System- og balansetjeneste, Statnett*
 - Demand Response: industry perspective
- Tor Kristian Gyland, *CEO (Chief Executive Officer), Green Mountain*
 - Green Mountain: industry perspective in designing and operating green datacenter



Invited Industry Experts (II)

- **Arne Øvrebø Lie, *Consultant, Energy Markets & Technology, DNV GL***
 - **Blockchain Technology and its Application in Energy Systems**



- **Ylvisåker Hans Terje, *Programsjef BKK SmartNett***
 - **Robot and Digitalization for Automatic and Real-time Power Grid**



- **Arne Gravdahl, *CTO & Founder, WindSim AS; Associate Professor, Norwegian University of Life Sciences***
 - **Wind Energy Forecasting: industry perspective**



Invited Industry Experts (III)

- **Jon Andreas Pretorius, *Director of IT, Hafslund Nett***
 - **Smart Grid Cyber-Security: industry perspective**
- **Vivi Mathiesen, *Head of Section, NVE***
 - **Energy Market and Nord Pool**
- **Boris Tistan, *Group Manager, Powel.AI***
 - **Machine Learning Applications for Intelligent Energy Systems**



Learning Goals

- **New knowledge, new concepts**
 - different energy systems - e.g., smart grid, electric vehicles, vehicle-to-grid, storage, transport, renewable energy resources
- **Good understanding**
 - where and how computer science techniques - e.g., machine learning, apply for future sustainable energy systems
 - connection between principles and their applications in real systems
- **Skills**
 - how to evaluate power systems with real data sets and mathematical and machine learning tools to assess the integration of renewable resources and electric vehicles
- **Connections**
 - meet industry invited speakers and top management

Benefits for Students

- New knowledge
 - energy system basics
 - state-of-the-art computer techniques
 - applying computer techniques in energy systems
- Chances to talk with industry invited experts and top management
 - Internship, new master projects, and job opportunities (**e.g., a student in Spring 2017/2018 got an internship in NVE/Statnett even when the course is not finished yet**)
 - You are strongly encouraged to contact and ask for internship and master thesis! (**e.g., a student got a master thesis in Hafslund**)
- More job opportunities
 - IT company
 - power companies, oil companies, transport companies that need strong ICT knowledge
 - government organizations, non-profit organizations

Lecture Elements

- **Seminars, 2.5 hours per week**
- **Invited speakers from industry**
- **Invited speakers from national/international universities or institutes**
- **Project assignments**
- **Group work (3-4 students in each group). More information will be given after the 3rd lecture**

Exam and Grades

- **Grading based on a weighted combination of**
 - **Oral examination at the end of seminar (70%)**
 - **Two project assignments (30%)**
- **Examination**
 - **Oral examination date: 3-4 June 2019**
 - **You are free to choose: date (03.06 or 04.06), timeslot (morning or afternoon), language (Norwegian or English). More information will be given later.**
- **Examination materials**
 - **The lecture notes**

Very welcome to contact us! suggestions, comments, jokes...

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- Sabita Maharjan, OsloMet, IFI@UiO

- Email: sabita@ifi.uio.no



- Stein Gjessing, IFI, UiO. Email: steing@ifi.uio.no

