EEE203 (18/19)

Continuous And Discrete Time Signals And Systems I

Xi'an Jiaotong-Liverpool University

西交利物浦大学

Contact information

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Research interests:

Image Processing, Computer Vision, Deep Learning

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My Research (AI & compuer vision)

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My Research (AI & compuer vision)

nuTonomy cabs ready for hailing in Singapore

Posted on August 26, 2016 in TRANSPORT

DAVID CURRY
Contributing Writer

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国务院近日印发《新一代人工智能发展规划》

明确了我国新一代人工智能发展的战略目标：

到2020年

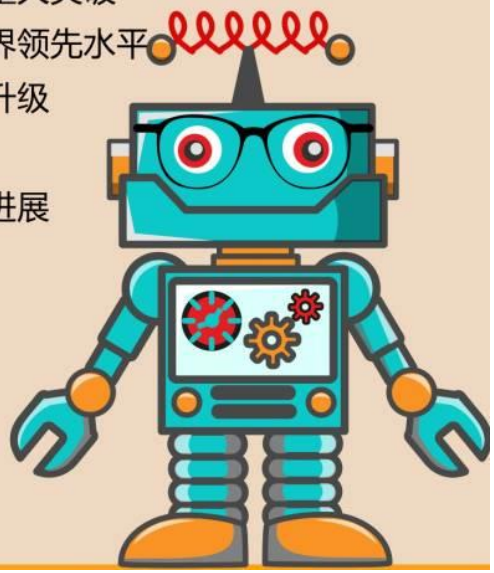
- 人工智能总体技术和应用与世界先进水平同步
- 人工智能产业成为新的重要经济增长点
- 人工智能技术应用成为改善民生的新途径

到2025年

- 人工智能基础理论实现重大突破
- 部分技术与应用达到世界领先水平
- 人工智能成为我国产业升级和经济转型的主要动力
- 智能社会建设取得积极进展

到2030年

- 人工智能理论、技术与应用总体达到世界领先水平，成为世界主要人工智能创新中心



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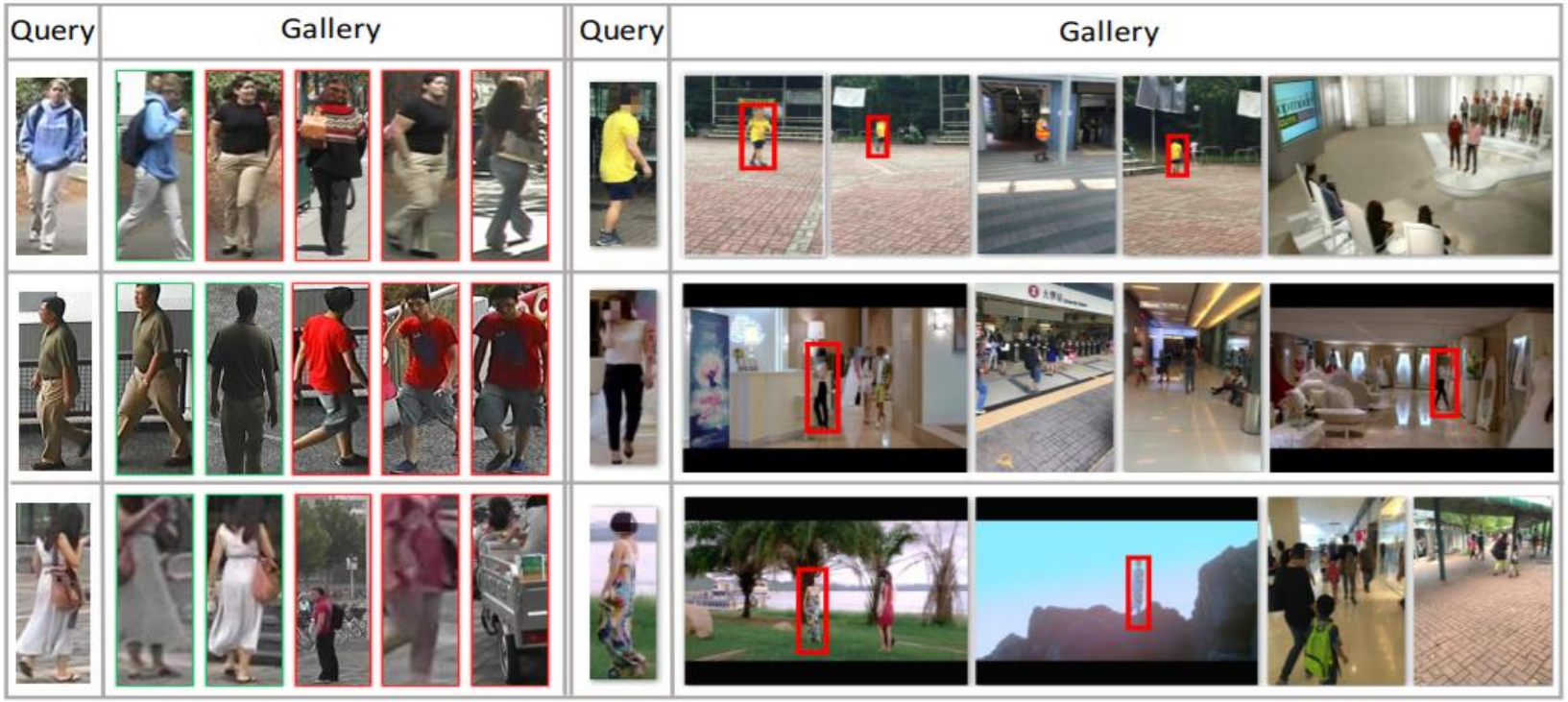
My Research (AI & compuer vision)



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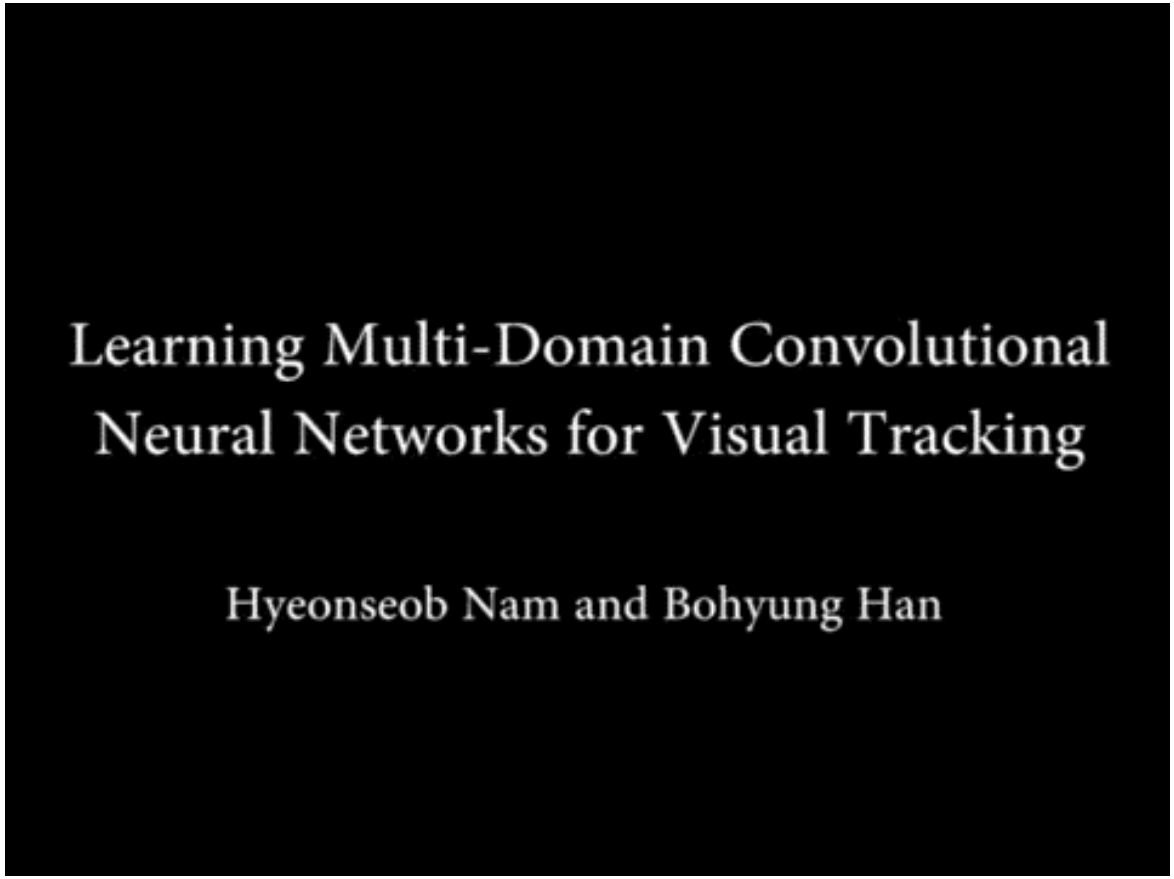

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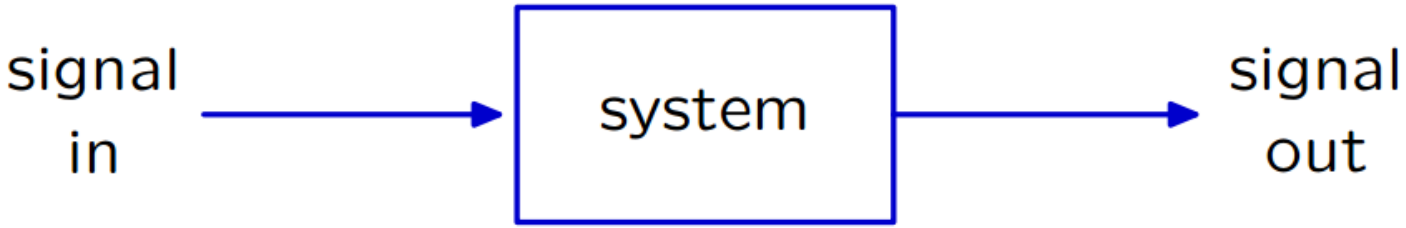
Signals and Systems Abstraction

Describe a system (physical, mathematical, or computational) by the way it transforms an input signal into an output signal.



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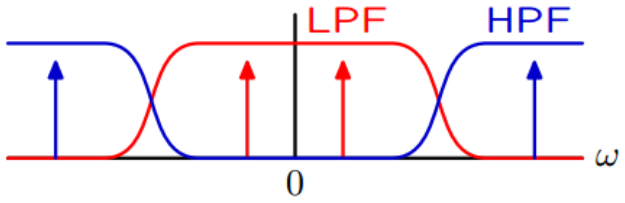
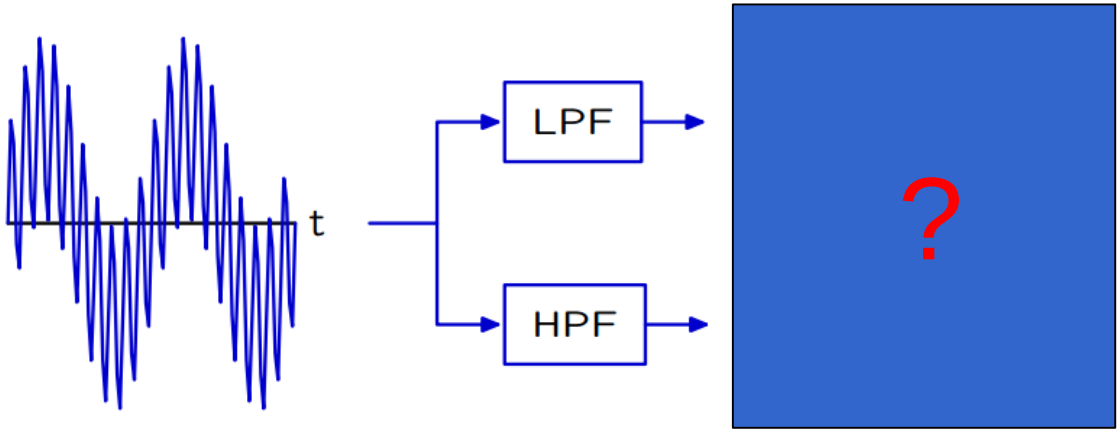
One example…

Systems can be designed to selectively pass certain frequency bands.

Examples: low-pass filter (LPF) and high-pass filter (HPF).





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The course aims to …

- **… present the concepts involved with signal and systems:**
  - Signals, and systems classification
  - Fourier series
  - Fourier transform
  - Laplace transform
  - Linear time-invariant (LTI) systems

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The course outcomes …

- **After successful completion of the module, the student should have :**
  - an understanding of the use of Fourier series to represent periodic signals;
  - an understanding of the use of Fourier transform to represent finite energy signals;
  - an understanding of the use of Laplace transform in circuit and system analysis;
  - an understanding of linear time invariant systems.

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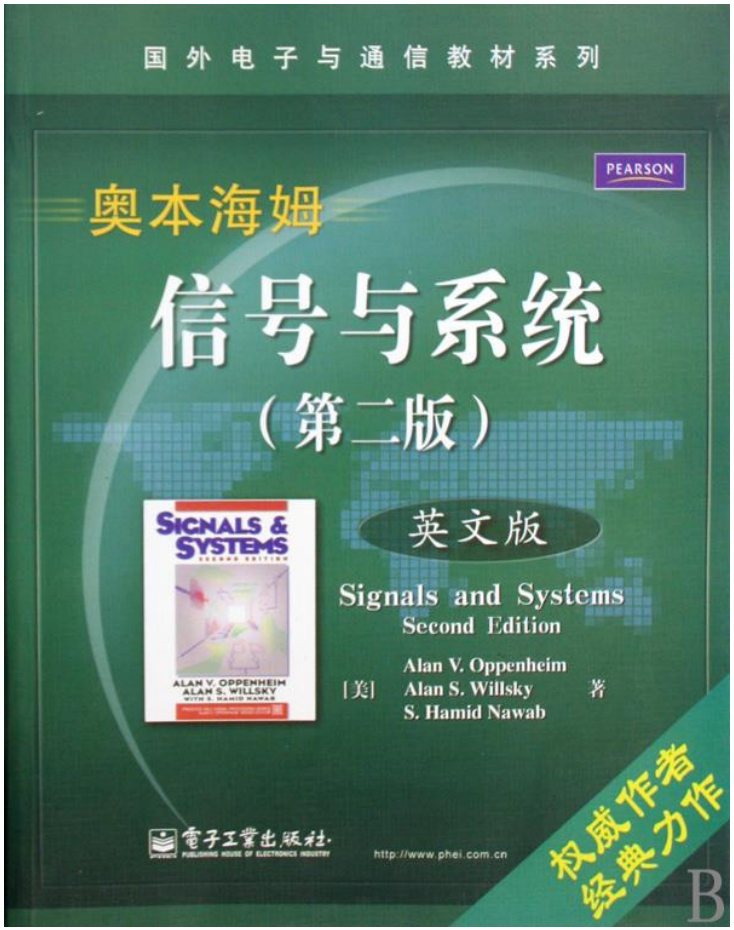
Course outline

- Signals and Systems (4 hours)
- Linear systems (2 hours)
  - LTI-system
  - Impulse response
  - Convolution of signals
- Fourier series (4 hours)
  - Fourier Series
  - Spectrum of a signal

Course outline

- Fourier transform (4 hours)
  - Fourier transform
  - Properties of Fourier Transform
- Laplace transform (4 hours)
  - Laplace transform and region of convergence
  - Properties of Laplace Transform
- System stability (it will be extensively covered in the Control System course) (2 hours)
  - Frequency response and transfer function
  - Feedback systems
  - BIBO stability

Recommended texts



Signals and Systems,

Alan V. OPPENHEIM and Alan S. WILLSKY and S. Hamid NAWAB.

MIT open coursware

http://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/

http://v.163.com/special/opencourse/signals.html

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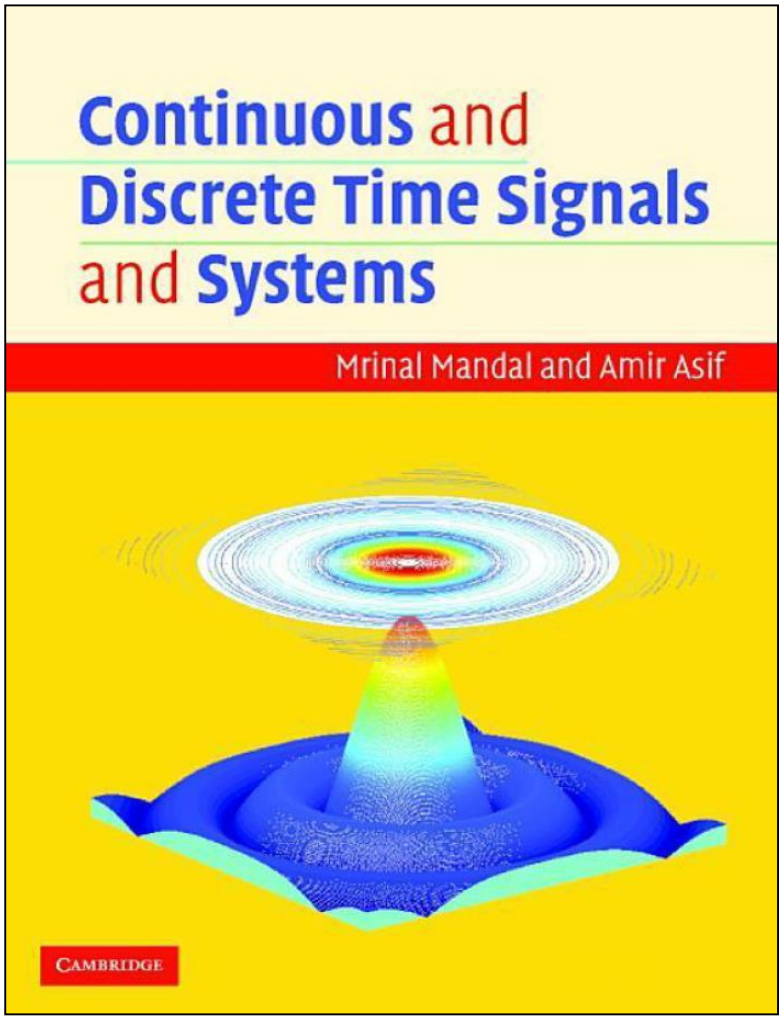
Recommended texts



- **References**
  - *Continuous and Discrete Time Signals and Systems*, *Mrinal MANDAL, Amir ASIF.*

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Recommended texts

- **References**
  - Signals and systems using the web and matlab, Edward w. KAMEN and bonnie s. HECK, Prentice-hall.
  - Communication Systems, A. Bruce CARLSON, Paul B. CRILLY, Janet RUTLEDGE.

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Useful Information

Lectures: **Tuesday 14:00-16:00, room: EE101**

~15 hours lectures,

~7 hours problem classes,

~4 hours lab: **week 12 in :EE213 and :EE215**

1 hour revision,

~~*1 hour mid-term exam*~~

2 take home assignments

2 hours final exam

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Assessment

- ***Final examination: 2 hours, 70%***
- ~~***Midterm test: 1 hour, 10%***~~
- ***2 take home assignments, 20%***
- ***Lab: 4 hours , 10% ; attend the lab and submit the report in time***

- The assignments and lab marks will be carried forward when evaluating the total re-sit mark, the total re-sit mark will be capped to 40

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How to pass this course

Come to the lecture! Unless…

Sit at the front.

Bring a paper and a pen.

Do the excise.

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Signals and Systems Abstraction

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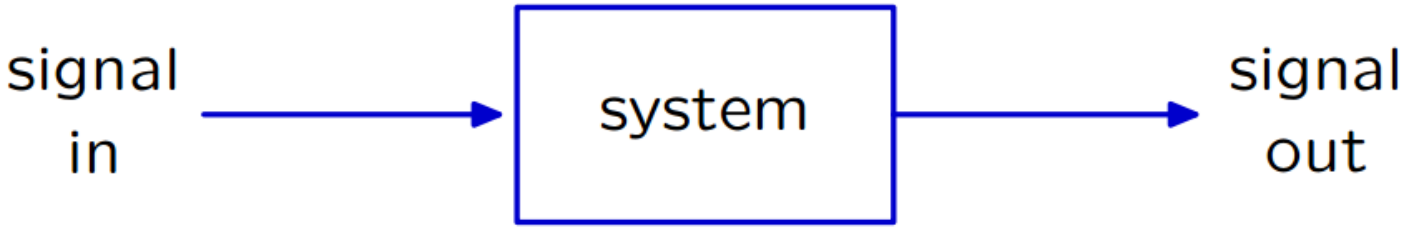

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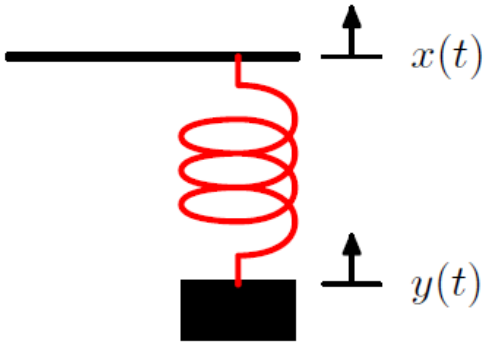
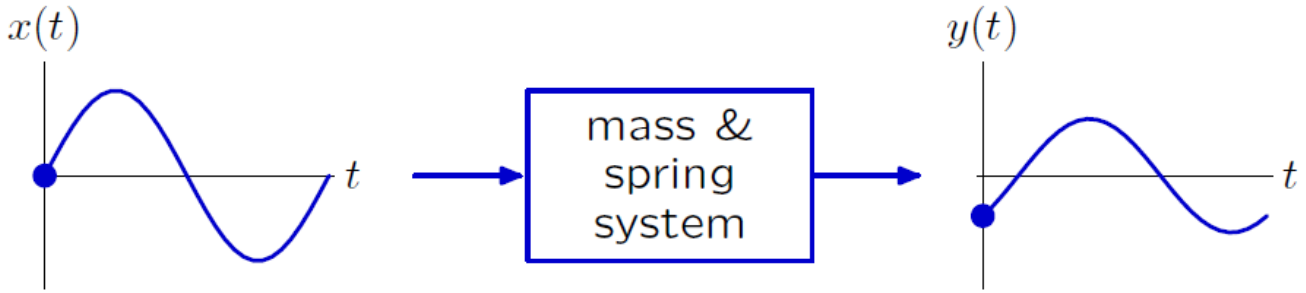
Example: Mass and Spring system





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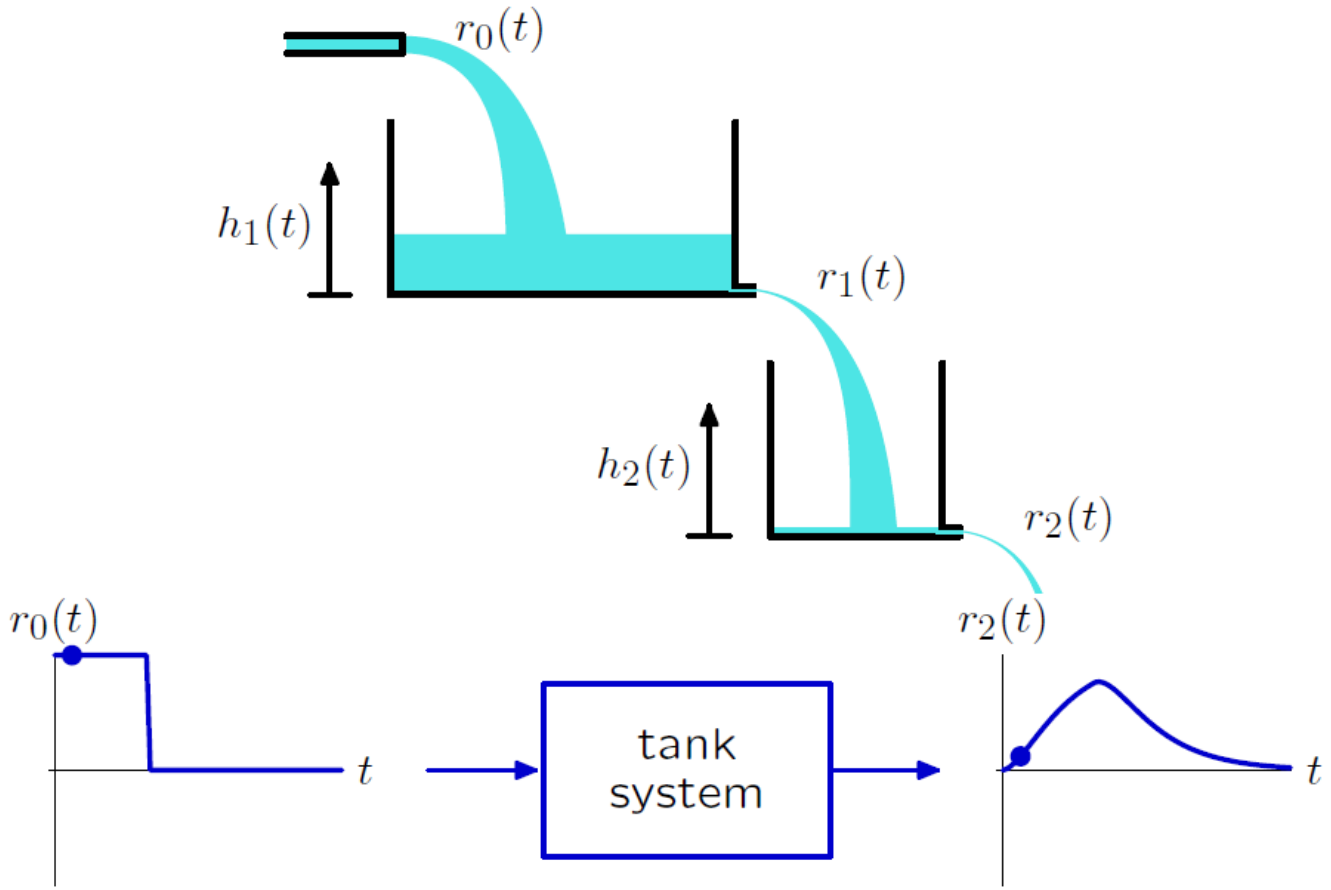
Example: Tanks



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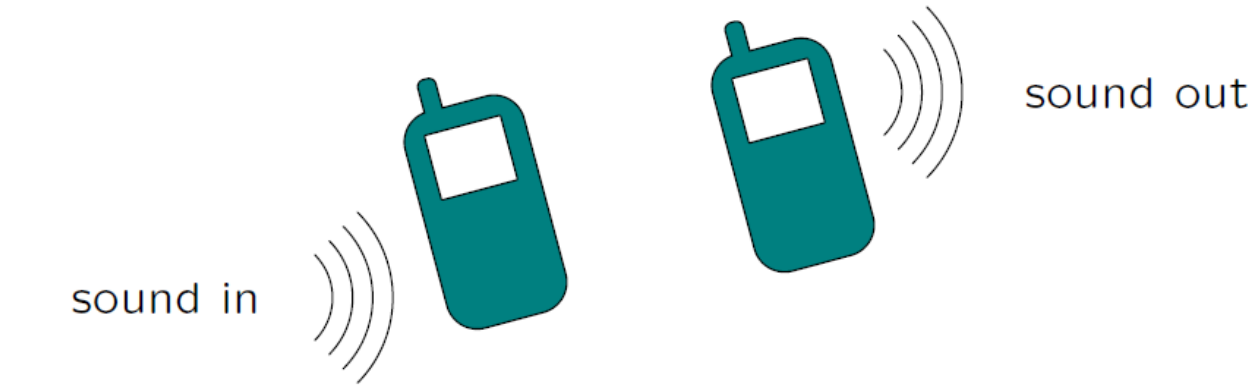
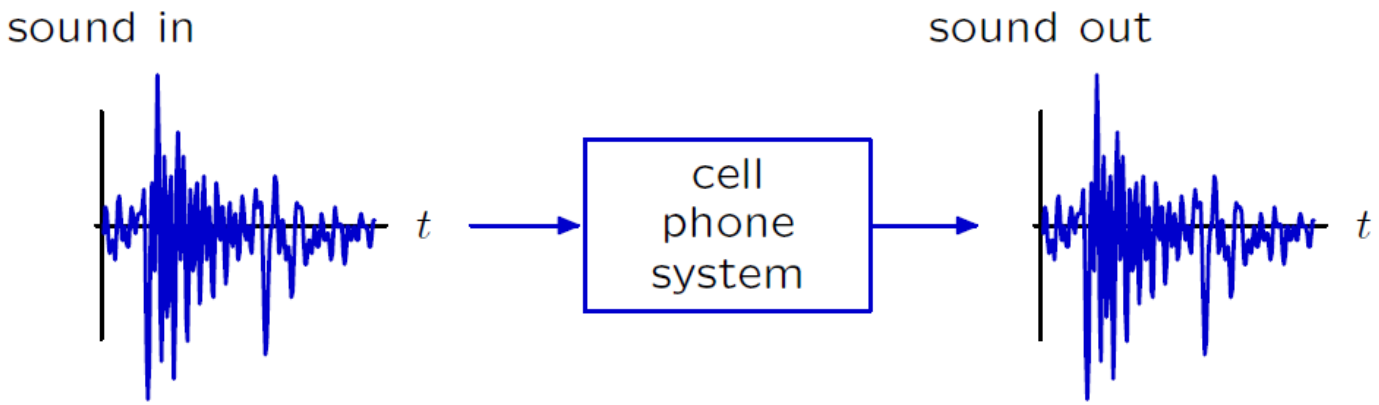
Example: Cell Phone System





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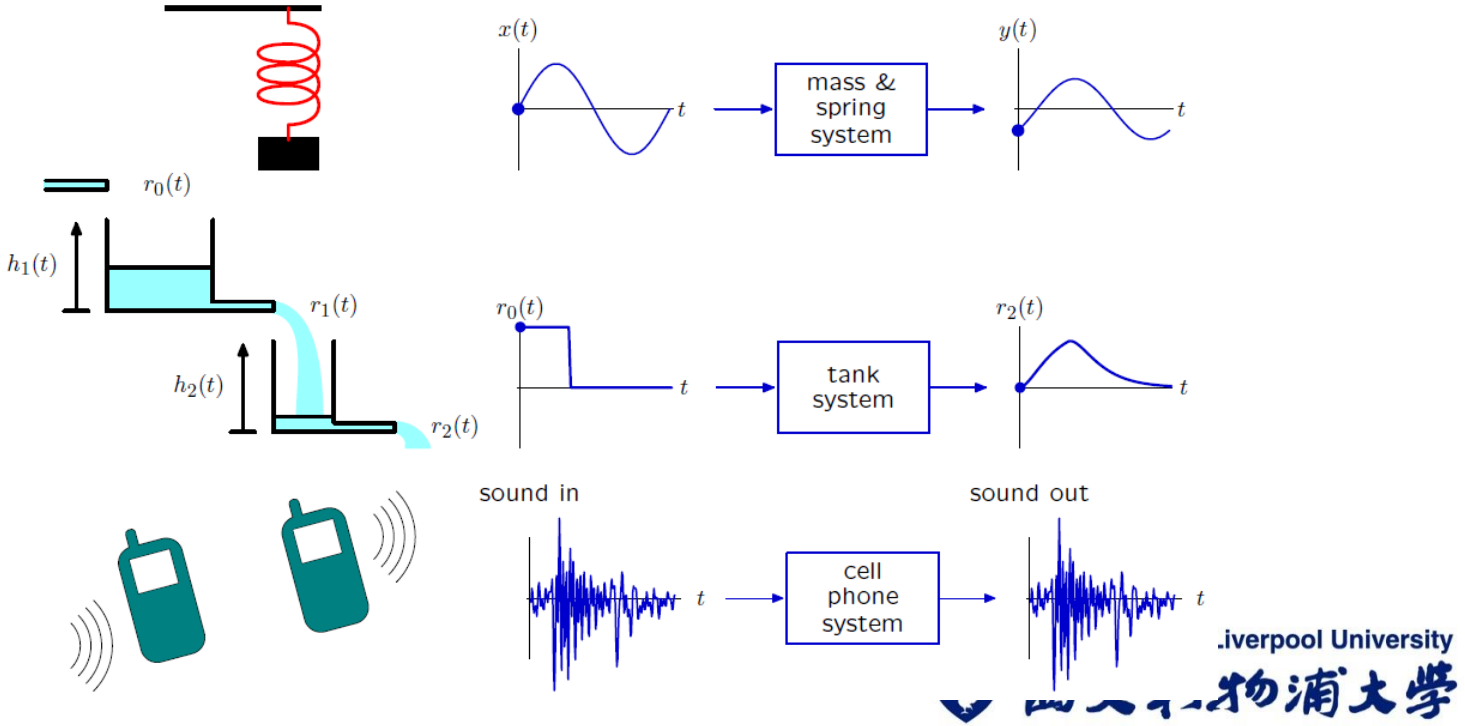
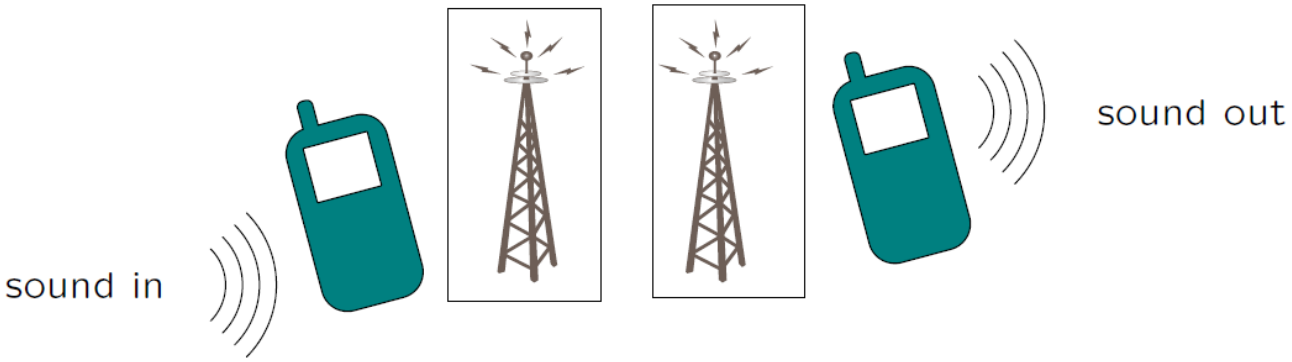
Signals and Systems: Widely Applicable

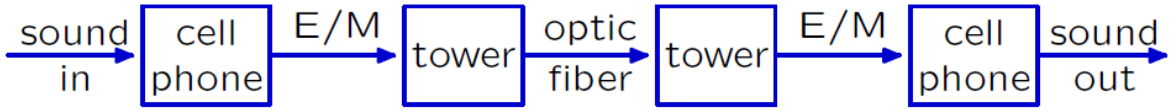
The Signals and Systems approach has broad application: electrical, mechanical, optical, acoustic, biological, financial, ...



Signals and Systems: Modular

The representation does not depend upon the physical substrate.



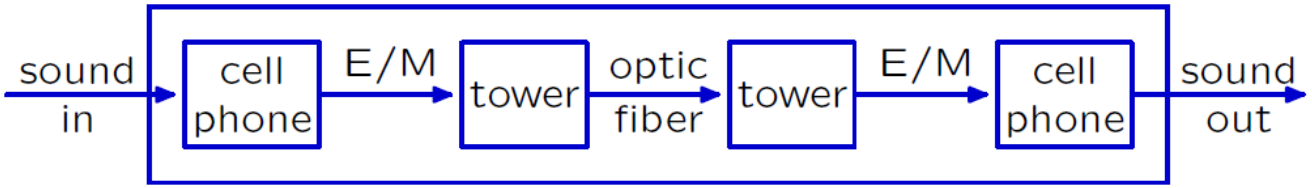


focuses on the flow of **information**, abstracts away everything else

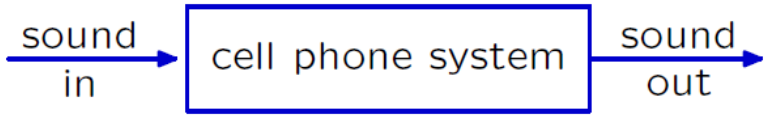
Signals and Systems: Hierarchical

Representations of component systems are easily combined.

Example: cascade of component systems



Composite system



Component and composite systems have the same form, and are analyzed with same methods.

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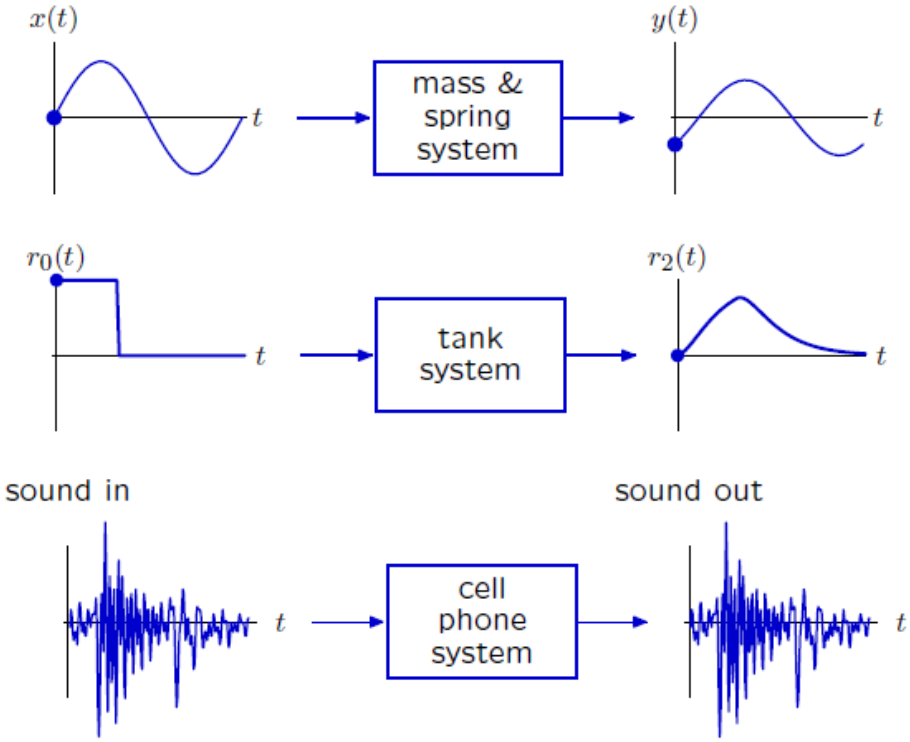
Signals and Systems

Signals are mathematical functions.

- independent variable = time
- dependent variable = voltage, flow rate, sound pressure



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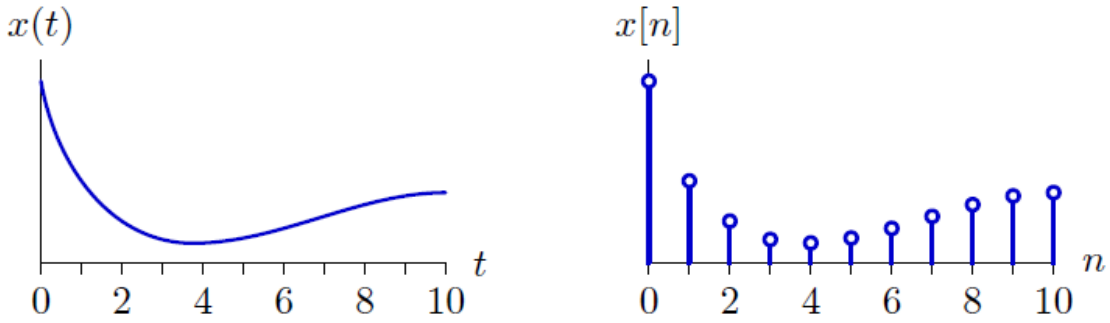
Signals and Systems

continuous "time" (CT) and discrete "time" (DT)



Signals from physical systems often functions of **continuous** time.

- mass and spring
- leaky tank

Signals from computation systems often functions of **discrete** time.

- state machines: given the current input and current state, what is the next output and next state.

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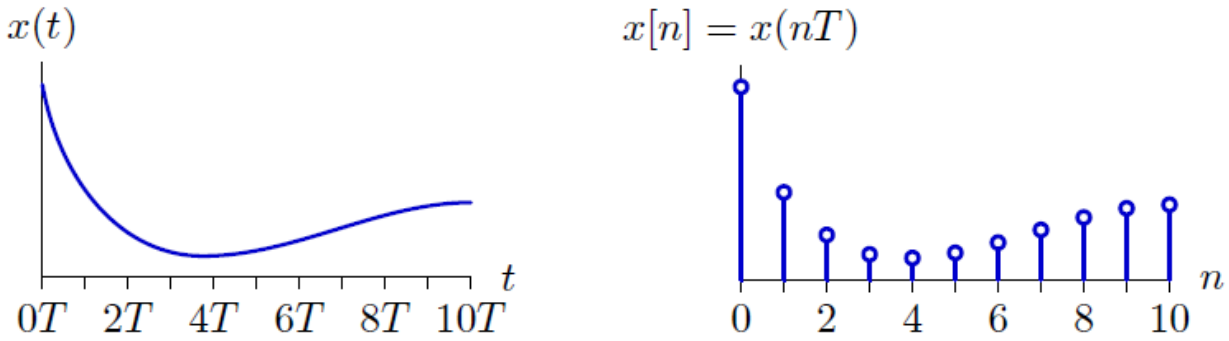
Signals and Systems

Sampling: converting CT signals to DT



T = sampling interval

Important for computational manipulation of physical data.

- digital representations of audio signals (e.g., MP3)
- digital representations of images (e.g., JPEG)

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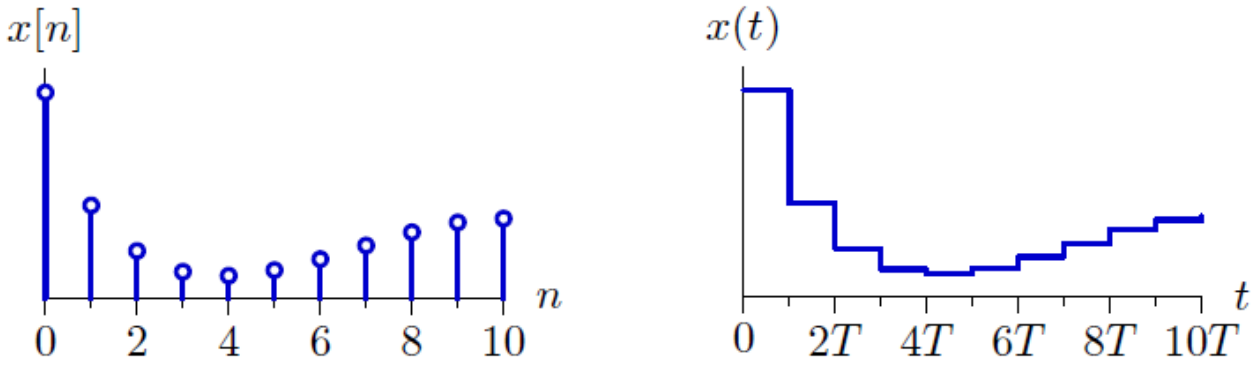
Signals and Systems

Reconstruction: converting DT signals to CT

zero-order hold



T = sampling interval

commonly used in audio output devices such as CD players

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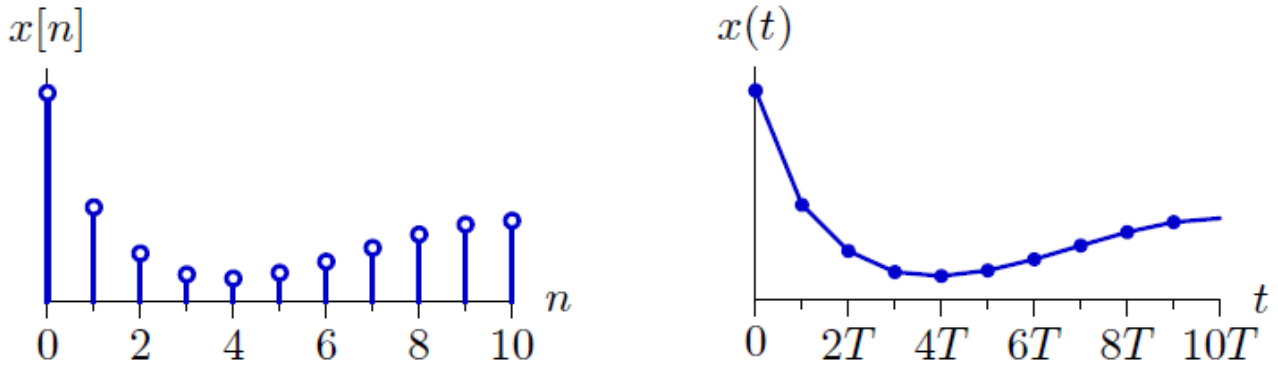
Signals and Systems

Reconstruction: converting DT signals to CT

piecewise linear



T = sampling interval

commonly used in rendering images

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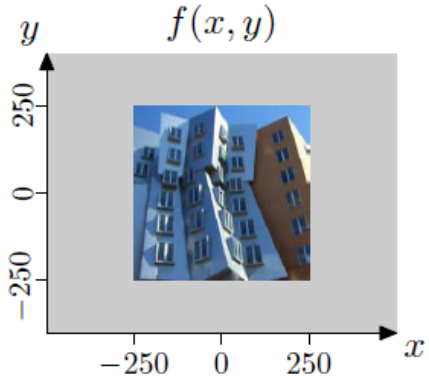
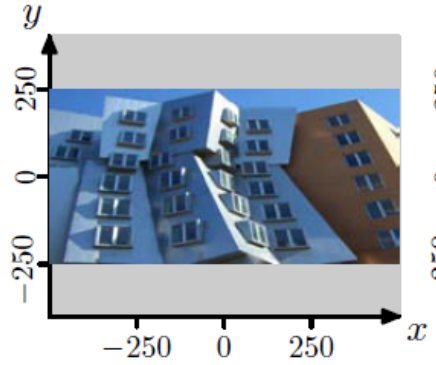
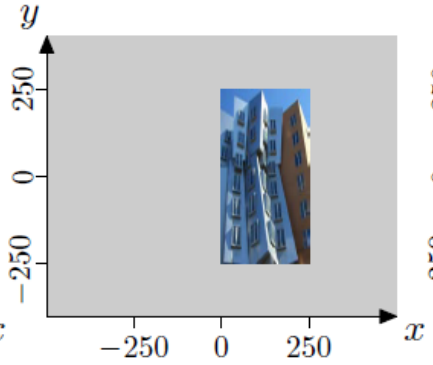
Check yourself



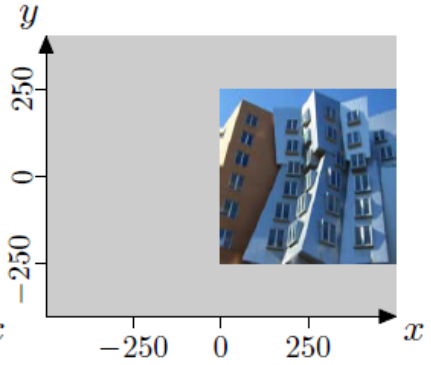
How many images match the expressions beneath them?



$f_1(x,y) = f(2x,y)$?

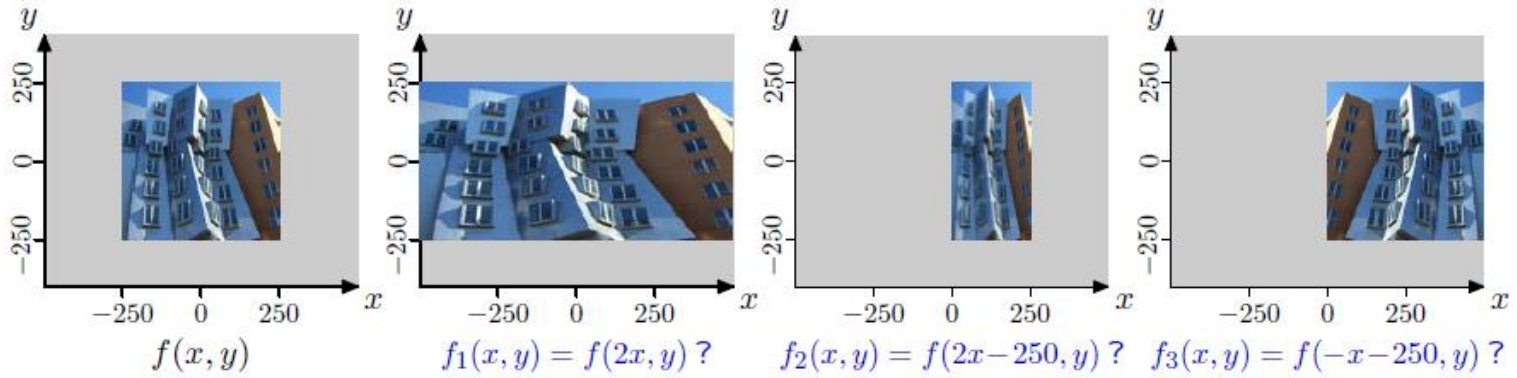


$f_2(x,y) = f(2x-250,y)$?



$f_3(x,y) = f(-x-250,y)$?

Check yourself



$f(x,y)$ $\quad f_1(x,y)=f(2x,y)$? $\quad f_2(x,y)=f(2x-250,y)$? $\quad f_3(x,y)=f(-x-250,y)$?

$$
\begin{aligned}
x=0 \quad &\rightarrow f_1(0,y)=f(0,y) && \surd \\
x=250 \quad &\rightarrow f_1(250,y)=f(500,y) && \times \\
x=0 \quad &\rightarrow f_2(0,y)=f(-250,y) && \surd \\
x=250 \quad &\rightarrow f_2(250,y)=f(250,y) && \surd \\
x=0 \quad &\rightarrow f_3(0,y)=f(-250,y) && \times \\
x=250 \quad &\rightarrow f_3(250,y)=f(-500,y) && \times
\end{aligned}
$$

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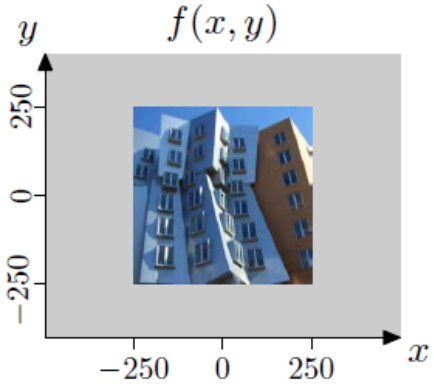
Check yourself



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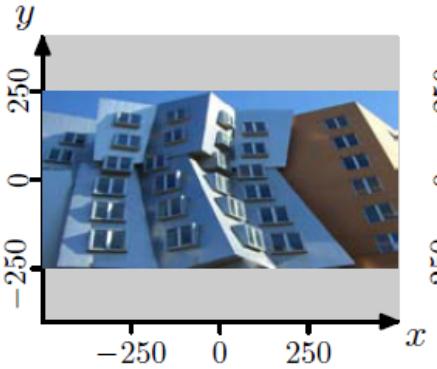
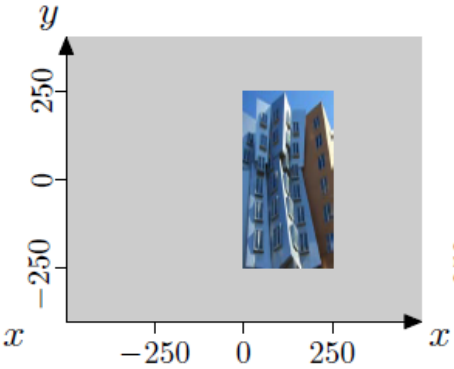
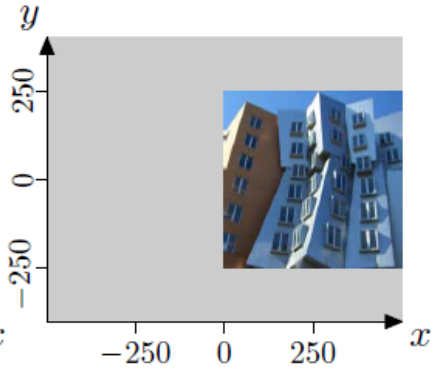


~~$f_1(x,y) = f(2x,y)$?~~



$f_2(x,y) = f(2x-250,y)$?



~~$f_3(x,y) = f($ $-250,y)$?~~

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Question?

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Acknowledgements

The course materials to be delivered in this course are prepared according to the following sources :

- **Prof. Tammam TILLO**
- **Dr. Yang Du**
- Materials taken from Wikipedia.org and the Internet.
- Prof. Enrico MAGLI, Politecnico di Torino;
- Prof. Trac D. TRAN, Johns Hopkins University, USA;