MOOCs
Open Online Learning
Peter Corke

a university for the real world®
CRICOS No. 00213J
MOOC - Massive Open Online Course

- Massive:
  - What is massive?
  - 100?
  - 1,000?
  - 10,000?
  - 100,000?

- Open:
  - Local cohorts?
  - Open registration?

- Online:
  - Self-paced?
  - Start/end dates?
  - College credits?

- Course:
  - Role of the instructor?
  - Learning community?
  - Open content?
  - Free of charge?
  - Affordable?
  - Real-time interaction?
  - Scripted assessments and feedback?
Once upon a time I wrote some MATLAB toolboxes...

Then a book...

Then I became a professor and started teaching (80 students at a time)

7 billion people in the world, this is going to take ages...

I'll need to be fit to do all that

So I decided to ride my bike to work

I rode, fell off, broke my patella (knee bone), 3 days before teaching starts

Out of action for 6 weeks

So I recorded my lectures at home and somebody played them to the class

MOOC!

At the end of semester I put the lectures on YouTube

Lots of people found them and said nice things

Maybe I could teach heaps of students at the same time...
Why make a MOOC?

ENB339 lecture 2: Image processing
2 years ago • 43,939 views
Introduction to digital images (greyscale), image processing, histograms, thresholds, smoothing, moments, blobs, area and centroid....

Robot Restaurant, Tokyo
1 year ago • 24,856 views
Visit to Robot Restaurant, Shinjuku, Tokyo, November 2013

ENB339 lecture 9: Image geometry and planar homography
2 years ago • 15,843 views
In this lecture we discuss in more detail the equation of image formation, particularly their expression in matrix form using homogeneous coordinates. We then introduce the planar...

ENB339 lecture 1: Introduction to robot vision
2 years ago • 14,124 views
QUT ENB339 Lecture 2/1.
...
create tools that others can use as they want
express concepts to readers in my own words
talk and demonstrate directly to students
What was in the box?

Each week

★ 2 lectures, each
  ‣ ~60 mins
  ‣ multiple “topic segments”, each
    - 5-10 mins long
    - 3-5 “check understanding” questions
  - transcript
★ multiple-choice quiz (20 points)
★ MATLAB programming assignments (20 points)
★ Optional project build
WORKING WITH BLOBS (6 points possible)

Blobs are groups of adjacent pixels of the same color. In the image above you can see a number of white blobs, and also a number of black blobs. Blobs can completely enclose one or more blobs of the opposite color, and those can be thought of as holes in the blob, or as children of the blob.

We will use the toolbox function I blobs to determine the number of different types of blobs in the scene.

1. Find all blobs within the image and save the result in the variable allBlobs.
2. Save the total number of white blobs in the variable numWhiteBlobs.
3. Save the total number of black blobs in the variable numBlackBlobs.
4. Save the number of white blobs with an area of more than 20,000 pixels in the variable numBigWhiteBlobs.
5. Save the area of the largest black blob that doesn’t touch the edge of the image in the variable areaLargestBlackBlob.
6. There is a hierarchical relationship between blobs, blobs have parents and children. There is one black blob that has four children. Save the area of this blob in the variable blobArea. Save the area of the parent of this blob in the variable parentArea. Only one of this blob’s four children has no children itself, save the area of that child in the variable childNoKidsArea.
7. There are many circles in the image, save the centroid of the largest circle in the variable largeCircleCentroid.
8. Save the area of the largest triangle in the variable largeTriangleArea.

The following MATLAB tutorials may be helpful:

- Accessing Elements of a Vector
- Logical Operators
- Conditional Data Selection
- If-Else Statement
- Array Size and Length

```matlab
% DO NOT MODIFY THE FOLLOWING LINE
im = imread('lotsblobs.png');

% YOUR ANSWER GOES BELOW
numWhiteBlobs = 0;
numBlackBlobs = 0;
```
QUESTION 1 (1 point possible)
A functional definition of a robot is a machine that (select all that apply):

- has a goal
- can sense its environment
- can make a plan to achieve its goal
- can move so as to carry out its plan

Show Answer
You have used 0 of 1 submissions

QUESTION 2 (1 point possible)
Robots are used to perform tasks that are (select 3 answers):

- dirty
- daring
- dull
- daunting
- dangerous

Show Answer
You have used 0 of 1 submissions

QUESTION 3 (1 point possible)
Robots use a variety of sensors to determine (select all that apply):

- their position in the world
- the state of the world around the robot

Show Answer
You have used 0 of 1 submissions

QUESTION 4 (1 point possible)
Which of the following shows a right-handed coordinate frame? (Select all that apply)
Introduction to robotics

- Feb 16 to 27 March 2015
- Book chaps 1-3, 7-9

1. Introduction & motivation
2. Where things are in 2D
3. Where things are in 3D
4. Creating smooth motion
5. Measuring motion
6. Robot arms & forward kinematics
7. Inverse kinematics
8. End point velocity & Jacobians
9. Over & under actuation
10. Robot independent joint control
11. Rigid body dynamics
12. Future of robotics & ethics
Robotic Vision

- 13 April to 22 May
- Chaps 10-13, 15

1. Robotic Vision
2. Getting images into the computer
3. Image processing
4. Spatial operators
5. Feature extraction
6. What is color?
7. Image formation
8. Image geometry
9. 3D vision
10. Advanced image processing
11. Vision and motion
Overview

Welcome to the start of our Introduction to robotics course. This week we will study:

- Lecture 1: Introduction to robotics
- Lecture 2: Where things are in 2D

We will look at where the idea of robots has come from and the difference between fictional and real robots. We also look at a number of useful real world robots and what they do. Then we get started on the problem of describing where things are in the world. We will start simply and consider the case of objects in a 2-dimensional plane. The skills you learn and the tools we use will be essential for the MATLAB exercises and the optional project.

Each lecture is a series of short videos on different topics. Begin by selecting Lecture 1 on the course menu to the left of your screen, then progress through each of the topics using the horizontal menu or the arrows at the top and bottom of the page.

Happy robotting!

[Signature]
MORE THAN 1M AT WORK

GPS + radio receiver

GPS + radio transmitter
Getting an image Functions in MATLAB

ROBOTIC VISION Robot Project
Important conventions

Use perimeter information

- Crack code
- 8-neighbour chain code

Colors:
- Red
- Orange
- Yellow
- Green
- Blue
- Magenta

Table of Normal vision (trichromats) and missing/defective (dichromats/anomalous trichromats):

<table>
<thead>
<tr>
<th></th>
<th>L-cone</th>
<th>M-cone</th>
<th>S-cone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>2.6%</td>
<td>6.2%</td>
<td>.001%</td>
</tr>
<tr>
<td>Women</td>
<td>.05%</td>
<td>.36%</td>
<td>.030%</td>
</tr>
<tr>
<td>Overall</td>
<td>2.65%</td>
<td>6.56%</td>
<td>.031%</td>
</tr>
</tbody>
</table>

**Simple averaging is also a kernel**

![Original image](image1.png)  ![Average each pixel over a 7x7 window](image2.png)

**Use perimeter information**

- Crack code
- 8-neighbour chain code

**Table: Normal vision vs. missing/defective vision**

<table>
<thead>
<tr>
<th></th>
<th>Normal vision (trichromats)</th>
<th>L-cone</th>
<th>M-cone</th>
<th>S-cone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>91.199%</td>
<td>2.6%</td>
<td>6.2%</td>
<td>.001%</td>
</tr>
<tr>
<td>Women</td>
<td>99.56%</td>
<td>.05%</td>
<td>.36%</td>
<td>.030%</td>
</tr>
<tr>
<td>Overall</td>
<td>90.759%</td>
<td>2.65%</td>
<td>6.56%</td>
<td>.031%</td>
</tr>
</tbody>
</table>

Source: Causes and incidences of colorblindness. Retrieved from [link](http://www.webexhibits.org/causesofcolor/IC.html)
Simple averaging is also a kernel

\[ G(u, v) = \frac{1}{2\pi \sigma^2} e^{-\frac{u^2 + v^2}{2\sigma^2}} \]

- Isotropic
- Decreasing weight away from centre

\[
K = \frac{1}{49} \begin{pmatrix}
1 & 1 & 1 & 1 & 1 \\
1 & 1 & 1 & 1 & 1 \\
1 & 1 & 1 & 1 & 1 \\
1 & 1 & 1 & 1 & 1 \\
1 & 1 & 1 & 1 & 1
\end{pmatrix}
\]
Rough figures

- Intro to Robotics: 13,000 enrolled
- Course pass: 620
- Projects: 30
- Robotic Vision: 7,700 enrolled
It had a global reach
<table>
<thead>
<tr>
<th>Country</th>
<th>New Users</th>
<th>Sessions</th>
<th>% New Sessions</th>
<th>Bounce Rate</th>
<th>Pages / Session</th>
<th>Avg. Session Duration</th>
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</thead>
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<td>25,377</td>
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<td>00:12:22</td>
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<td>21.6000%</td>
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<td>22.2700%</td>
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<tr>
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<tr>
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<tr>
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<td>14.2800%</td>
<td>29.0800%</td>
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<td>00:11:36</td>
</tr>
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</table>
The robot project

1. Create your robot
2. Upload YouTube video
3. Peer review 3 other robots
About the participants …

Pre: Student motivations for enrolling in the MOOC

- To help my employment prospects
- General interest or enjoyment
- Taking a course with Professor Peter Corke
- Earning a Statement of Participation
- Connecting with others interested in the topic
- Professional interest in robotics
- I am studying university level robotics
- Other reasons
- No response
... their age & gender
... educational attainment & MOOC experience
Feedback was gathered after the course
Engagement over time

Percentage of engagement with assessment by week

- Quiz attempted
- MATLAB attempted
- Quiz passed
- MATLAB passed

Week 1 through Week 6
Thanks, Prof. Corke, MOOC TA's and the whole QUT & EdCast team. This is my first MOOC and I am converted; it has been a fun, educational experience. I've had a great time learning the math behind my crazy bots. I would also like to thank the 12,000-odd new friends I have, my MOOC classmates.

I've greatly enjoyed reading and occasionally responding to your comments and interacting with you. Thanks to all!
I'll be taking the Vision course, so hopefully I'll "see" many of you there. Best of luck to all in your future endeavors, with and without robots!
Dave
Well designed courses like this, take (so) much effort, time, and management. I appreciate all from this team ...

If there is anything that we can return to you as a symbol of gratitude, it is our promise to make a better future for everyone on the Earth (and other planets) using the things we learn from you.

Good luck, thank you and keep on good work ...
Looking forward to your CV MOOC ...
Credentials

Open Badges help you share your skills & interests with the world:
Big thanks to tiny.cc/robomoocs