Accelerating MATLAB algorithms

- Code improvement
- Parallel computing
- C code generation

Ellie Dobson, DPhil
Application Engineer
Want faster MATLAB code?
Want faster MATLAB code?

yes

Optimise

Accelerate through code improvement
Where are the bottlenecks?

- unnecessary output
- memory allocation
- vectorisation
How long can you work on making a routine task more efficient before you’re spending more time than you save? (Across five years)

<table>
<thead>
<tr>
<th>Time Shaved Off</th>
<th>How Often You Do the Task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50/day</td>
</tr>
<tr>
<td>1 second</td>
<td>1 day</td>
</tr>
<tr>
<td>5 seconds</td>
<td>5 days</td>
</tr>
<tr>
<td>30 seconds</td>
<td>4 weeks</td>
</tr>
<tr>
<td>1 minute</td>
<td>8 weeks</td>
</tr>
<tr>
<td>5 minutes</td>
<td>9 months</td>
</tr>
<tr>
<td>30 minutes</td>
<td>6 months</td>
</tr>
<tr>
<td>1 hour</td>
<td>10 months</td>
</tr>
<tr>
<td>6 hours</td>
<td>2 months</td>
</tr>
<tr>
<td>1 day</td>
<td>8 weeks</td>
</tr>
</tbody>
</table>
Want faster MATLAB code?

Optimise

Parallelise

Accelerate with parallel computing
Tailoring Parallel Computing

Options available

CPU

Built in support

Ease of Use

Task intensive

Data intensive

parfor jobs & tasks

distributed arrays
spmd communicating job

Greater Control
multiple local cores
cluster
GPU arrays
Tailoring Parallel Computing

Ease of Use

Options available

GPU

gpuArray
arrayfun
CUDA code

Greater Control
Computation time exceeds data transfer time?

- **yes**
  - Running independent operations on many elements?
    - **yes**: Parallelise on GPU
    - **no**: Stick with CPU

- **no**: Stick with CPU
Want faster MATLAB code?

Optimise

Parallelise

Generate MEX

Accelerate with MATLAB Coder
Introducing MATLAB Coder

MATLAB code

```
function [mean, std] = stats(vals)
% #codegen
% calculates a statistical mean and a standard

std = sqrt(sum((vals - avg(vals, len)).^2)/len);
coder.extrinsic('plot');
plot(vals, 'o-');
```

C code

```java
public static void Main(
    List<Circle> circleList = new List<Circle>();
circleList Add(new Circle(3, 0, 5));
circleList Add(new Circle(1, 4, 10));

List<Rectangle> rectangleList = new List<Rectangle>();
rectangleList Add(new Rectangle(0, 0, 10, 20));
rectangleList Add(new Rectangle(2, 40, 20));

List<Triangle> triangleList = new List<Triangle>();
triangleList Add(new RightTriangle(20, 40, 1, 2))
triangleList Add(new RightTriangle(200, 400, 11, 21))
```
Want faster MATLAB code?

Optimise

Parallelise

Generate MEX

...thanks for listening