CS 111

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Overview

Section 1

Exam Info

General Statistics

$$\texttt{Mean} = 57.56/69.0 = 83.42\%$$

$$\texttt{Median} = 60.0/69.0 = 86.96\%$$

$$\sigma = 9.5/69.0 = 13.76\%$$

Question 2(c)

For $k = 40$, in the temperature problem, how many elements of A are non-zero?

Approximately,

$$5 \times 1600 = 8,000$$

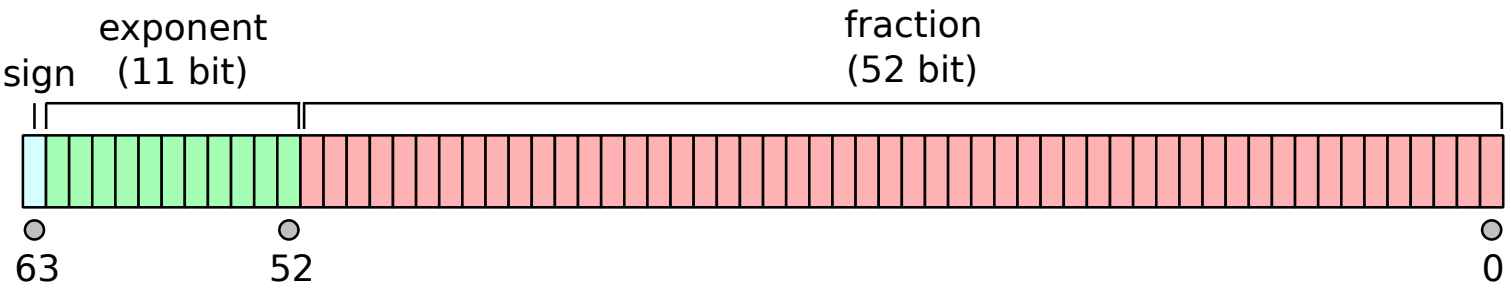
Question 4(c and d)

After QR factorization in "economic" mode, $Q^T Q = I$; however, QQ^T is not always the identity matrix.

Section 2

Floating Point Number Representation

Double Precision Floating Point



$$(-1)^{\text{sign}} \left(1 + \sum_{i=1}^{52} b_{52-i} 2^{-i}\right) \times 2^{e-1023}$$

Number One

```
>> fprint(1)

input      : 1
as float64: 1.0000000000000000e+00
as hex     : 3ff0000000000000
sign       : 0 means +
exponent   : 3ff means 1023 - 1023 = 0
mantissa   : 1.0000000000000000000000000000000000000000000000000000

0 01111111111 0000000000000000000000000000000000000000000000000000
```

$$= 2^0 \times 1 = 1$$

What is?

0 10000000001 0000000000000000000000000000000000000000000000000000

Number Four

```
input      : 4
as float64: 4.0000000000000000e+00
as hex     : 4010000000000000
sign       : 0 means +
exponent   : 401 means 1025 - 1023 = 2
mantissa   : 1.0000000000000000000000000000000000000000000000000000

0 10000000001 0000000000000000000000000000000000000000000000000000
```

Section 3

IEEE 754 Properties

IEEE 754

You can assume that calculations are done in the following order:

- Perform the calculation exactly with all the precision of the 2 floating point numbers
- Round the result to fit into 64 bit float representation.

Example With Two Significant Digits

If you round first,

$$5.6 + 6.6 = 6 + 7 = 13$$

However, if you round in the last step,

$$5.6 + 6.6 = 12.2 = 12$$

Rounding Modes

How do you round 3.35? Why?

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Round so that the least significant digit is even, 3.4.

Rounding Modes

How do you round 3.35? Why?
Round so that the least significant digit is even, 3.4. All other rounding modes will be statistically biased.

Special "Numbers"

$$\frac{x}{0} = \infty$$

$$\frac{-x}{0} = -\infty$$

$$\frac{-x}{0} + \frac{x}{0} =$$

Special "Numbers"

$$\frac{x}{0} = \infty$$

$$\frac{-x}{0} = -\infty$$

$$\frac{-x}{0} + \frac{x}{0} = \texttt{NaN}$$

Special "Numbers"

Figure: Not spelled NaN.. but still makes me hungry..

Section 4

TPU's and Tensorflow

Co-processors

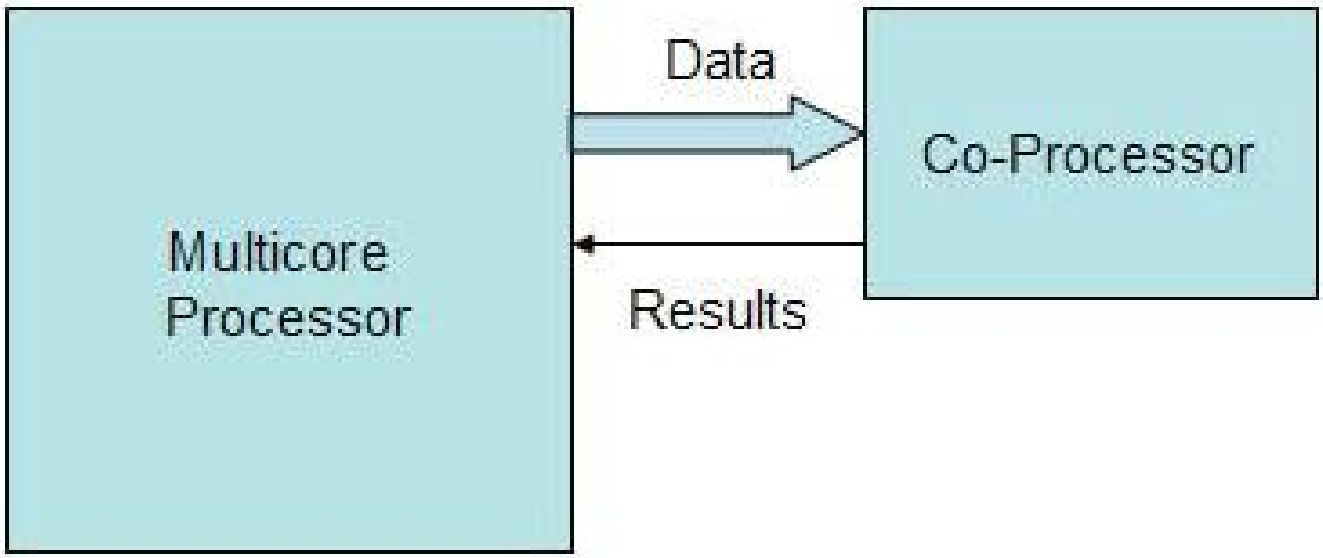


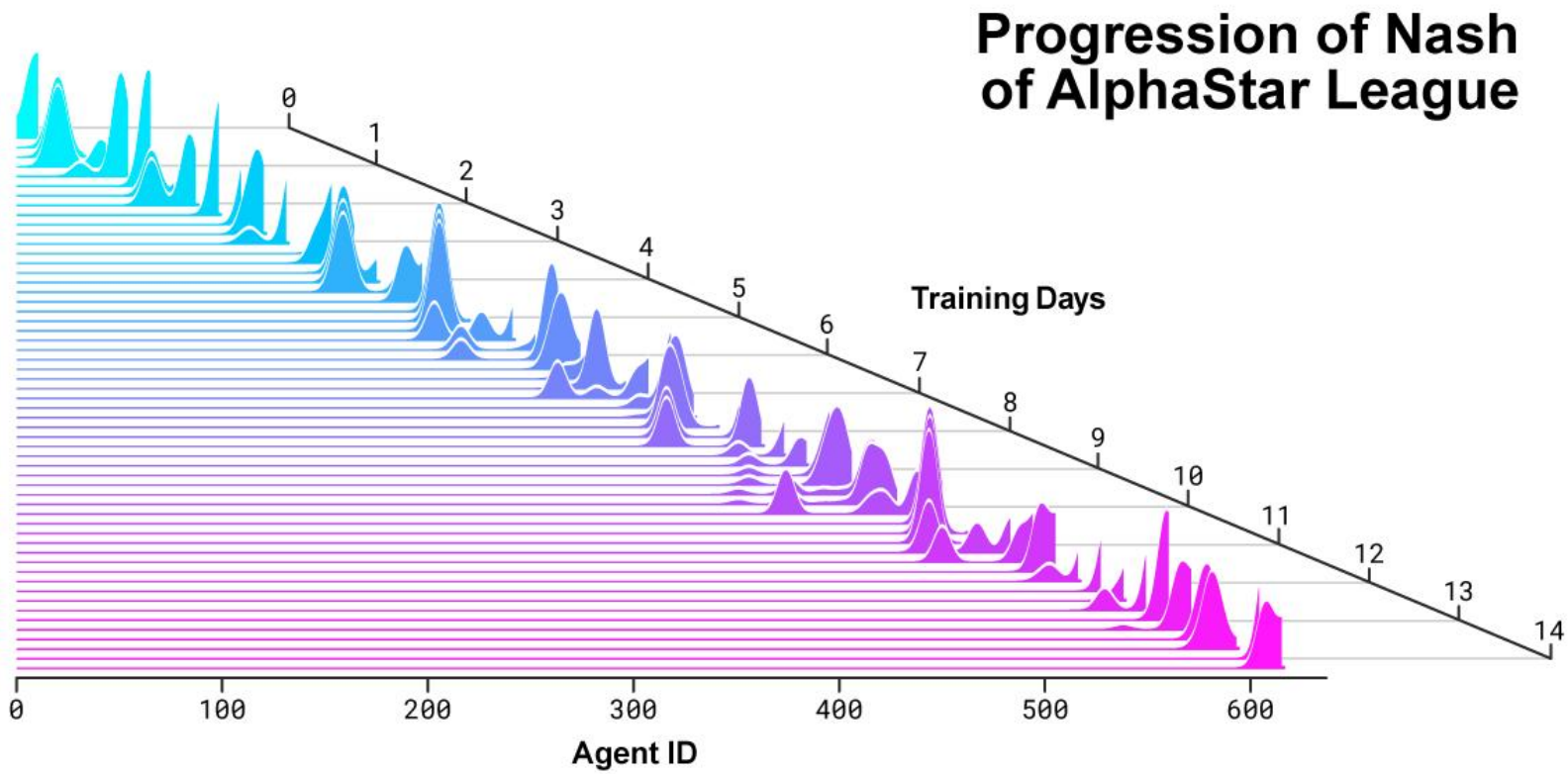
Figure 1: A typical configuration of a multicore processor and a coprocessor.

Deepmind's AlphaStar

Alpha Star

The AlphaStar league was run for 14 days, using 16 TPUs for each agent. During training, each agent experienced up to 200 years of real-time StarCraft play.

Alpha Star


Progression of Nash
of AlphaStar League
Training Days
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
0
100
200
300
400
500
600
Agent ID

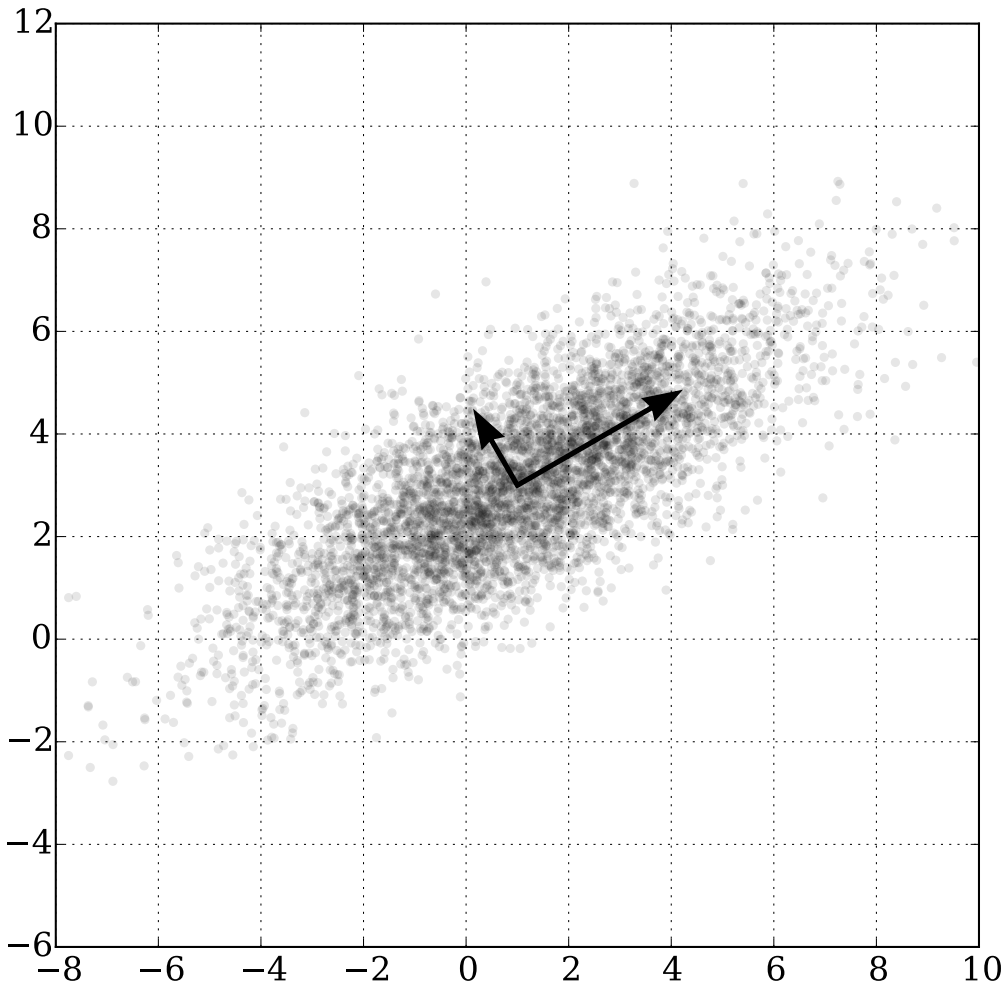
Google TPU's

600 agents times 200 years of gameplay.. 120,000 years!

Section 5

Eigenfaces

PCA Analysis



PCA Analysis

$$x = \sum_i a_i \mu_i$$

Where $A^T A \mu_i = \lambda \mu_i$

Eigenfaces