

# Artificial Intelligence Methods Assignment 1

## Exercise 1

a) \_ \_ \_ \_ \_

out of 52 cards in a deck i choose five  
the order doesn't matter, so i can use the formula

$$\frac{n!}{k!(n-k)!}$$

$$\binom{52}{5} = \frac{52!}{5!47!} = \frac{52 \cdot 51 \cdot 50 \cdot 49 \cdot 48}{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} = 2598960$$

b) an atomic event - a specific five card poker hand -  
one of all the possibilities

$$\frac{1}{2598960}$$

c) Royal straight flush

AS KING QUEEN JACK TEN of the same suit

$$4 \cdot \frac{1}{2598960} = \frac{4}{2598960}$$

↓  
there are 4 suits in poker  
a specific atomic event of an as, king, queen, jack and ten of the same suit

Four of a kind

□ □ □ □ 2

48 possibilities for the remaining card

$$\frac{13 \cdot 48}{2598960} = \frac{624}{2598960} = \frac{1}{4165}$$

there are 13 ranks in poker



## Exercise 2

a) bar/bar/bar  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$  bell/bell/bell  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$  lem/lem/lem  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$  ch/ch/ch  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$  ch/ch/?  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{3}{4}$  ch/?/?  $\frac{1}{4} \cdot \frac{3}{4} \cdot \frac{4}{4}$

ch/ch/?  $\frac{1}{4} \cdot \frac{1}{4}$  this can be anything besides a cherry - so  $\frac{3}{4}$

ch/?/?  $\frac{1}{4} \cdot \frac{1}{4}$  this cannot be a cherry -  $\frac{3}{4}$  this can be anything - even a cherry, because a ch/3/ch combination wasn't already taken into consideration by the previous winning sequences  $\frac{4}{4}$

the expected payback

$$20 \cdot \frac{1}{64} + 15 \cdot \frac{1}{64} + 5 \cdot \frac{1}{64} + 3 \cdot \frac{1}{64} + 2 \cdot \frac{3}{64} + 1 \cdot \frac{4}{64} = \frac{61}{64}$$

bar/bar/bar bell/bell/bell lllll ch/ch/ch ch/ch/? ch/?/?

b) bar/bar/bar  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$  bell/bell/bell  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$  lem/lem/lem  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$  ch/ch/ch  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{1}{4}$  ch/ch/?  $\frac{1}{4} \cdot \frac{1}{4} \cdot \frac{3}{4}$  ch/?/?  $\frac{1}{4} \cdot \frac{3}{4} \cdot \frac{4}{4}$

$$\frac{1}{64} + \frac{1}{64} + \frac{1}{64} + \frac{1}{64} + \frac{3}{64} + \frac{12}{64} = \frac{19}{64}$$

c) The mean and median number of plays you can expect to make until you go broke are:

The mean: approximately 200

The median: approximately 21

## Exercise 3 Part One

a) probability that at least 2 people have the same birth date - to calculate this it is easier to first calculate the probability of finding a group of N people without repeated birthdays

P(A) - probability of finding a group of N people without repeated birthdays

$$P(A) = \frac{365!}{(365-N)! \cdot 365^N} = \frac{365!}{(365-N)! \cdot 365^N}$$

the number of possibilities that N people have birthdays on different days

the number of possibilities of N people having birthdays

$$P(B) = 1 - P(A) = 1 - \frac{365!}{(365-N)! \cdot 365^N}$$

In this interval, what is the proportion of N where the event happens with the least 50% chance?

The event happens with at least 50% chance for  $N = [23, 50]$  which is **0,68** of the interval  $[10, 50]$ .

What is the smallest N where the probability of the event occurring is at least 50%?

**N = 23**

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The probability that at least 2 people out of 10 have the same birth date is: 0.11694817771107768
The probability that at least 2 people out of 11 have the same birth date is: 0.141141378321733
The probability that at least 2 people out of 12 have the same birth date is: 0.16702478883806438
The probability that at least 2 people out of 13 have the same birth date is: 0.19441027523242937
The probability that at least 2 people out of 14 have the same birth date is: 0.223102512004973
The probability that at least 2 people out of 15 have the same birth date is: 0.25290131976368635
The probability that at least 2 people out of 16 have the same birth date is: 0.2836040052528499
The probability that at least 2 people out of 17 have the same birth date is: 0.31500766529656066
The probability that at least 2 people out of 18 have the same birth date is: 0.34691141787178936
The probability that at least 2 people out of 19 have the same birth date is: 0.37911852603153673
The probability that at least 2 people out of 20 have the same birth date is: 0.41143838358057994
The probability that at least 2 people out of 21 have the same birth date is: 0.4436883351652058
The probability that at least 2 people out of 22 have the same birth date is: 0.4756953076625501
The probability that at least 2 people out of 23 have the same birth date is: 0.5072972343239854
The probability that at least 2 people out of 24 have the same birth date is: 0.5383442579145288
The probability that at least 2 people out of 25 have the same birth date is: 0.5686997039694639
The probability that at least 2 people out of 26 have the same birth date is: 0.598240820135939
The probability that at least 2 people out of 27 have the same birth date is: 0.626859282263242
The probability that at least 2 people out of 28 have the same birth date is: 0.6544614723423994
The probability that at least 2 people out of 29 have the same birth date is: 0.680968537477777
The probability that at least 2 people out of 30 have the same birth date is: 0.7063162427192686
The probability that at least 2 people out of 31 have the same birth date is: 0.7304546337286438
The probability that at least 2 people out of 32 have the same birth date is: 0.7533475278503207
The probability that at least 2 people out of 33 have the same birth date is: 0.774971854175772
The probability that at least 2 people out of 34 have the same birth date is: 0.7953168646201543
The probability that at least 2 people out of 35 have the same birth date is: 0.8143832388747152
The probability that at least 2 people out of 36 have the same birth date is: 0.8321821063798795
The probability that at least 2 people out of 37 have the same birth date is: 0.8487340082163846
The probability that at least 2 people out of 38 have the same birth date is: 0.8640678210821209
The probability that at least 2 people out of 39 have the same birth date is: 0.878219664366722
The probability that at least 2 people out of 40 have the same birth date is: 0.891231809817949
The probability that at least 2 people out of 41 have the same birth date is: 0.9031516114817354
The probability that at least 2 people out of 42 have the same birth date is: 0.9140304715618692
The probability that at least 2 people out of 43 have the same birth date is: 0.9239228556561199
The probability that at least 2 people out of 44 have the same birth date is: 0.9328853685514263
The probability that at least 2 people out of 45 have the same birth date is: 0.940975899465775
The probability that at least 2 people out of 46 have the same birth date is: 0.9482528433672547
The probability that at least 2 people out of 47 have the same birth date is: 0.9547744028332994
The probability that at least 2 people out of 48 have the same birth date is: 0.9605979728794224
The probability that at least 2 people out of 49 have the same birth date is: 0.9657796093226765
The probability that at least 2 people out of 50 have the same birth date is: 0.9703735795779884
The proportion of N where the event happens with at least 50% chance 0.6829268292682927
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## Part Two

How large a group should Peter expect to form?

Peter should expect to form a group of around 2300 people.