# Project For Mathematic Software, T1-2016

This project worths 22% of your course grade (7% preparation and 15% presentation). You may choose one of the suggested projects below or come up with your own problem. On Friday, December 2 you will make a 10-20 minutes presentation using beamer program.
Please feel free to ask me for help.

## 1 Monty Hall

a) Proof rigorously the probability of winning when use the switching strategy.

b) Simulate the probability of winning with switching strategy if there are $n+m$ doors with $n$ cars and $m$ goats.

c) Simulate the probability of winning with switching strategy if there are $n+m$ doors with $n$ cars and $m$ goats. This time the host reveals $k$ goat door where $0 \leq k \leq m-1$.

d) What is the chance to win a car if the host reveals the goat door and offers an option to switch the door with probability $p$?

## 2 Coupon Collector

a) Proof rigorously that $T(n) = nH(n)$.

b) Let $U(n)$ be number of pictures to buy to complete Two Album with $n$ motif each. Is there anything you could say about the rate of growth of $U(n)$?

## 3 Knight Tour

a) Find the number of Knight tour on $4 \times 4$ board.

b) Find the number of Knight tour on $3 \times n$ board. Check the sequence with Sloane's integer sequence website. Is there a closed form formula for it?

c) Find the number of Knight tour on $4 \times n$ board. Check the sequence with Sloane's integer sequence website. Is there a closed form formula for it?

d) Try part a)-c) again. This time the board is wrapped around from north-south and east-west.

## 4 Finite Values of Erdós's Conjecture

a) Let $A \subset \{1, 2, 3, \dots\}$ and the function $v(A) = \sum_{a \in A} \frac{1}{a}$. Find the maximum value of $v(A)$ from any set $A$ which does not contain a 3-term arithmetic progressions.

Example If $A = \{1, 2, 4, 8, \dots\}$, $A$ does not contain 3-term arithmetic progressions (why?) and $v(A) = \sum_{n=0}^{\infty} \frac{1}{2^n} = 2$. Can you do better?

b) Similarly, find the maximum value of $v(A)$ from any set $A$ which does not contain a 4-term arithmetic progressions.

## 5 The Pancake Problem