Middle East Technical University

Department of Computer Engineering

CENG 111

Fall 2015

Take Home Exam 2

REGULATIONS

Due date: 23:59, 18 December 2015, Friday *(Not subject to postpone)*

Submission: Electronically. You should save your program source code as a text file named `the2.py` and submit it to us via the course's COW page.

Team: There is **no** teaming up. This is an EXAM.

Cheating: Source(s) and receiver(s) will be treated equally, will receive zero and will be subject to disciplinary action.

INTRODUCTION

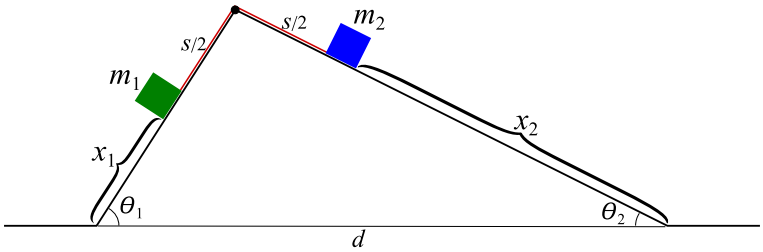
This exam is about calculating the final positions of two masses on inclined surfaces with friction.

Two blocks each of which is a cube with 10 cm edges have masses m_1 and m_2, respectively. They are connected over a massless rope of length s passing through a frictionless and massless pulley (assume that the pulley has zero radius). The pulley is located at the tip of the inclined surfaces. Each mass resides on one of the inclined surfaces. The inclined surface which has m_1 on forms an angle θ_1 with the horizontal axis. Similarly, the other inclined surface makes an angle of θ_2 with the horizontal axis. The distance between the inclined surfaces' end points, which are on the horizontal axis, is d.

Both inclined surfaces have a static friction coefficient of μ_s and a kinetic friction coefficient of μ_k.

The system starts at $t = 0$ from the rest state, having the rope's mid-point exactly on the pulley. Depending on μ_s, the masses may (or may not) start moving. After a time t_1, the rope is cut instantly. When the rope is cut, the system that may (or may not) have been moving reacts accordingly. The output that you are expected to generate are x_1 and x_2, the positions of the masses, respectively, after a time t_2 that has passed after the rope is cut.

If it is the case that a mass moves down its inclined surface it finally hits the horizontal axis and comes to a stop immediately. It remains so indefinitely.



TASK & SPECIFICATIONS

In this problem you are going to write a function that you will name as `physics` that takes a single argument, namely a list of ten floating points:

$$[\theta_1,\ \theta_2,\ d,\ \mu_s,\ \mu_k,\ s,\ m_1,\ m_2,\ t_1,\ t_2]$$

The ten values are as explained in the previous section.

- The values are in MKS (meter, kilogram, second) system. Angles are in degrees. Take $g = 9.8\, m/s^2$
- The only external force on the system is gravitation.
- $s + 0.1 <$ length of the shorter inclined surface
- $t_1 \geq 0$, $t_2 > 0$
- $\theta_{1,2} < 90^o$
- You are allowed to use the `math` module of python. You can do this using the following python statement:
  `from math import *`
  For the functions provided in this module, refer to:
  `https://docs.python.org/2/library/math.html`
  Attention: The trigonometric functions of the `math` module expect angles in radians.
- The movement of a block stops (instantly) when its upper corner touches the pulley or the lower corner touches the horizontal ground. It is also possible that one of the masses is stuck at the pulley when the two masses are connected. This will cause the other mass to stop as well.
- The pulley is massless, frictionless and dimensionless. It should be assumed as the point of the tip.
- Your function `physics` will **return** a **list** of two floating points, the distances x_1 and x_2 at time $t = t_1 + t_2$:

$$[x_1,\ x_2]$$

HINT

`http://mech.subwiki.org/wiki/Pulley_system_on_a_double_inclined_plane`

NOTES

- Your function will be tested with multiple data.
- Any program that performs only 30% and below will enter a glass-box test (eye inspection by the grader TA). The TA will judge an overall THE2 grade in the range of [0,30].
- Tests will tolerate possible floating-point round-off errors (as introduced in lecture). The glass-box test grade is not open to discussion nor explanation.
- A program based on randomness will be graded zero.
- 50% of the test cases will have $t_1 = 0$.
- Your function will be tested on python that is installed on inek machines running linux.
- You are encouraged to share input-outputs on the news group of the course.