Define lel variable \ events

P(A | B)
P(B|A)

Cognitive Robotics

Assignment 1

1.1) A person receives a positive outcome on a first-stage test for a serious but rare disease. The test reports false positives with a probability of 0.005. For simplicity, we assume that there are no false negatives. Can you assess the probability of the person actually suffering from the disease? (Hint: distinguish carefully between the proposition that the test diagnoses the disease and the proposition that the person is ill).
What is your estimate, given that one out of 50000 in the population suffers from this disease? harvard lecture 5, correct ans: 3.98 x 10^-3

4 points

	HD	DHD
P	✓	FP
N	FN	

Define our variables:
* D: the person actually has a dieses

* !D: the person does not have a dieses.

* T : the person is tested Positive.

* !T: the person is tested negative.

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1. P(T | !D) = 0.005
2. P(!T | !D) = 1 - 0.005
3. P(!T | D) = 0
4. P(T | D) = 1
5. P(D) = 1 / 50,000

RTF:

$$P(D \mid T) = \frac{P(T \mid D)\, P(D)}{P(T)}$$

$$P(D \mid T) = \frac{P(T \mid D)\, P(D)}{P(T|D)\, P(D) + P(T|!D)\, P(!D)}$$

correct first time , ans is 3/11

1.2) A robot is equipped with an unreliable person detector that outputs either "Person" or "No person". If there is a person in front of the robot, it indicates "Person" with probability 0.7.
However, if there is no person in front of the robot, the detector also indicates "Person" with probability 0.2.
Before observing the detector, the prior belief of the robot about a person being in front of it is 0.5.
What is the posterior probability of a person being in front of the robot when the detector outputs "No Person"?

4 points

noyeec probleem yasta, vt+1 = vt, dt+1 = dt + vt correct ans [1, 0.1] = A
[0 1]

1.3) Consider a two-dimensional state $\boldsymbol{x}=(x_1, x_2)$, where x_1 is the position of a cart (in m) and x_2 is its velocity (in m/s). The distance between two time steps t and $t+1$ is 0.1 seconds.
Describe the matrix A that maps $\boldsymbol{x}_t$ to $\boldsymbol{x}_{t+1}$ in the noiseless case: $\boldsymbol{x}_{t+1}=A\,\boldsymbol{x}_t$.

2 points

x = [dt]
[vt]

[Dt+1] = M [dt]
[Vt+1] [vt]

2x1 2x2 2x1

[0.005]
[0.1]

Dt+1 = Dt + (t+1 - t)v + (T/2) a^2 0
Vt+1 = (0)(Dt) + Vt + Tat 0
At+ 1 = (0) Dt + (0) Vt + at

M = [i j]
[k L]

1.4) Consider now control actions u_t (in m/s²) that accelerate the cart constantly during a time step.
How should matrix B look like that maps control actions to state changes: $\boldsymbol{x}_{t+1}=A\,\boldsymbol{x}_t + Bu_t$?

2 points

1.5) Suppose you can only measure velocity. How should matrix C look like that maps state to measurements z_t, $z_t = Cx_t$?

2 points

[0] vt = C[dt]
[1] [vt]

[Vt] 1x2

[dt]
[Vt] 2x1

C
[0 1] 1x2

1.6) Start with a state $x_0=(3, -1)$ that has a Covariance $\Sigma_0=(4, 0,$
$0, 1)$.

Assume that the Motion has noise covariance $R = (0.1, 0\ ,$
$0\ , 0.04)$.

What is the prediction of a Kalman filter for $t=1$ (=0.1s) when $u_1=3m/s^2$? Compute mean and the covariance of the state.

3 points

1.7) Now, we make a position measurement of $z_1= 2m$ with standard deviation 0.1. What are the mean and the covariance of the corrected state?

3 points

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