Mathematics Considerations for Mature Students

1 Familiarity with relevant mathematics

Mature students may come to the B.Sc./M.Sc. in Artificial Intelligence and Machine Learning without a recent exposure to some of the mathematics used in the course. While this should not be a barrier to a mature entrant, a prospective student who finds the following examples unfamiliar should reflect on this.

1. If $A = \begin{pmatrix} 3 & 1 \\ -4 & 2 \end{pmatrix}$ and $\vec{x} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}$, what is $A\vec{x}$?
2. What is $\int_0^3 x^2\,dx$?
3. What is y as a function of x, if $y = 2\frac{dy}{dx}$?
4. A bag contains 3 red balls and 5 black balls. A person takes a random ball from the bag, notes the colour and returns the ball to the bag. The person then does this a second time. What is the probability that first and second balls drawn from the bag are both red?

The learning and application of mathematics at university is a different experience from secondary school, and relevant mathematics arises in each module, where it is contextualized in problem solving and is less intimidating.

2 Mathematics Learning Centre

In addition to the normal supports that are in place within courses, all UL students studying courses such as the B.Sc./M.Sc. in Artificial Intelligence and Machine Learning that have a mathematics or statistics module can avail of the Mathematics Learning Centre's (MLC) services free of charge. The Mathematics Learning Centre provides maths support services for students. These services can be found in the 'Opening Hours' tab in the menu of the MLC site. MLC's online resources can be accessed via the 'Online Resources' tab in the menu of the MLC site. All services are based on a supervised self-help model that integrates faculty, students, media, and ICT inputs and approaches.

3 Special Mathematics Exam

For normal entrants who do not meet the formal mathematics requirement of the course, UL provides a Special Mathematics Exam that can be used instead of Leaving Certificate maths to meet an entrance criterion. The Special Mathematics Exam has grade parity with the Leaving Certificate Higher Mathematics for course applications, where points are considered.

4 Worked example using mathematics

A worked example using the kind of mathematics on the course is provided below.

4.1 Integration (Question only)

Imagine you work from home and use your computer mostly during office hours (9 AM to 5 PM). You're interested in finding out how much electrical energy your computer uses over the course of a day, assuming the power usage varies throughout the day.

Using the power consumption graph (Figure 1), estimate how much total energy (in watt-hours) the computer consumes in a day. Note: Energy is the area under the curve of power vs. time, where the curve is defined by the function:

$$P(t) = 50 + 150e^{-\frac{1}{2}\left(\frac{t-13}{2.5}\right)^2}$$

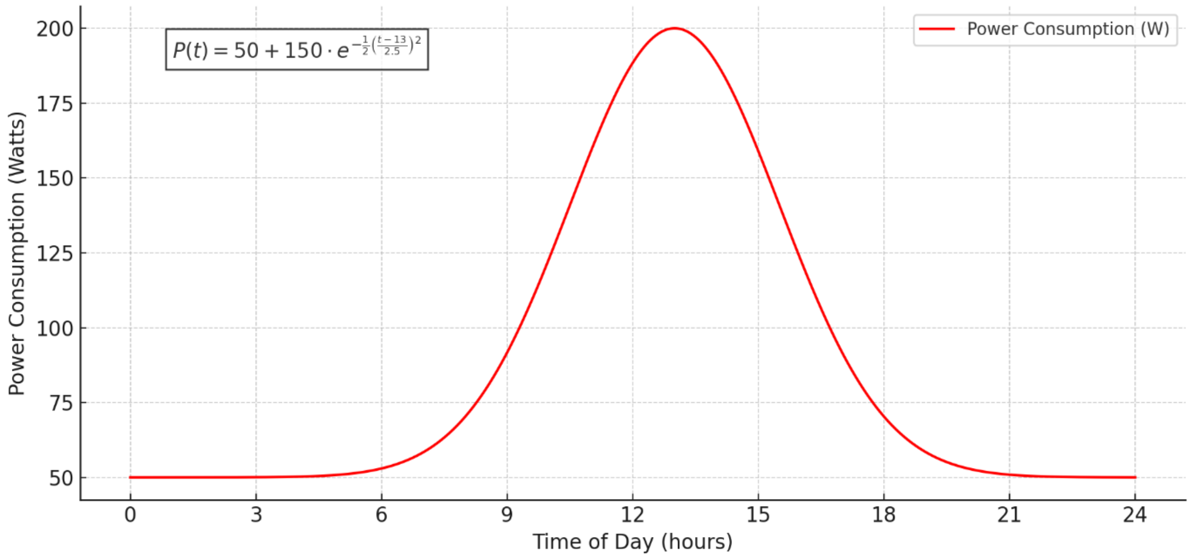

Figure 1: Power consumption over a 24 hour period

4.2 Integration (Solved mathematically)

To find the totally energy usage in watt-hours we integrate the power over the time:

$$E = \int_0^{24} P(t)dt$$

Substituting the expression for $P(t)$:

$$E = \int_0^{24} \left(50 + 150e^{-\frac{1}{2}\left(\frac{t-13}{2.5}\right)^2}\right) dt$$

which can be separated into two parts as follows:

$$E = \int_0^{24} 50dt + \int_0^{24} 150e^{-\frac{1}{2}\left(\frac{t-13}{2.5}\right)^2} dt$$

From this we know that,

$$\int_0^{24} 50dt = 50 \times 24 = 1200.$$

The remainder $\int_0^{24} 150e^{-\frac{1}{2}\left(\frac{t-13}{2.5}\right)^2}\, dt$ can be solved numerically, e.g., using software.

4.3 Integration (Estimated using trapezoidal rule)

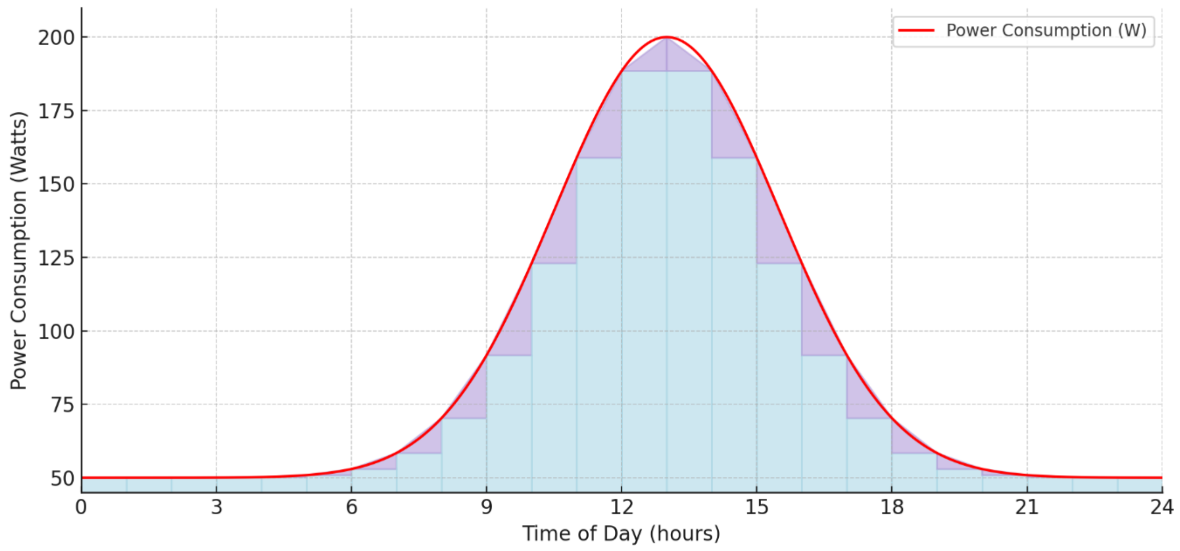

Figure 2 : Power consumption over 24 hours treated using the trapezoidal rule

Knowing that:

$$\text{Area of a rectangle} = \text{base} \times \text{height}$$

$$\text{Area of a triangle} = \frac{1}{2}\text{base} \times \text{height}$$

the power consumed between 03:00 and 04:00 can be estimated with:

$$\text{Area} = \text{base} \times \text{height}$$

$$\text{Consumed power} = (4 - 3)\text{ hours} \times 50\text{ Watt} = 1 \times 50 = \mathbf{50\ Wh}$$

Similarly, the power consumed by 12:00-13:00 is:

$$\text{Total area} = (\text{Area}_{\text{rectangle}}) + (\text{Area}_{\text{triangle}})$$

$$\text{Total area} = \left(\text{base}_{\text{rectangle}} \times \text{height}_{\text{rectangle}}\right) + \left(\frac{1}{2}\text{base}_{\text{triangle}} \times \text{height}_{\text{triangle}}\right)$$

$$\text{Consumed power} = (13 - 12) \times 180 + \left(\frac{1}{2} \times (13 - 12) \times 15\right) = \mathbf{187.5\ Wh}$$

The total area under the curve can be estimated by summing the area of each 1 hour period.