**Assignment – 1, 2**

Course: SC-374

Computational and Numerical Methods

Instructor: Prof. Arnab Kumar

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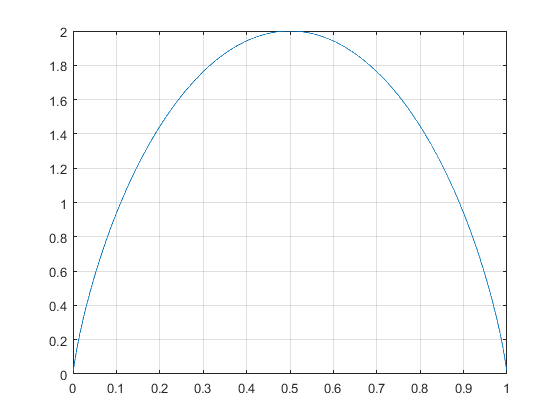
Rutvik Kothari – 201601417

**Assignment - 1**

**The Binary Search and Information Entropy**

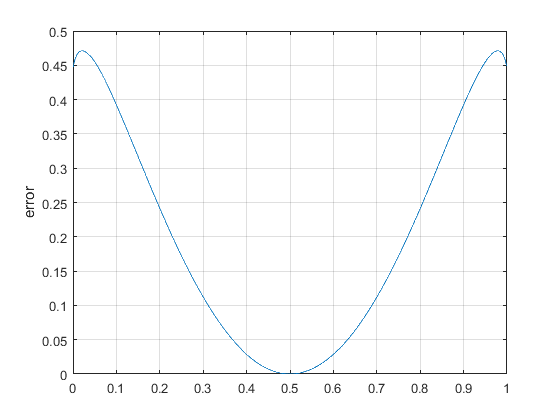
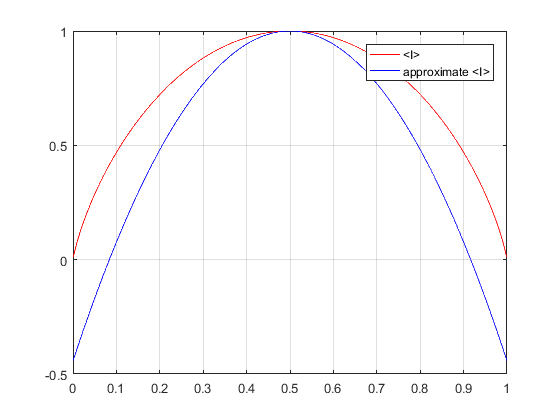
Average information content is given by the formula, , in which is constant and is the probability of an event.

1. For a two-outcome problem (eg. a coin toss), Show that peaks at .



1. Apply a very small perturbation as , in which Show that in this perturbative approach , with and .

1. Plot for both the actual function and the approximate function together and then compare the graph for closeness on the line. For plotting choose.



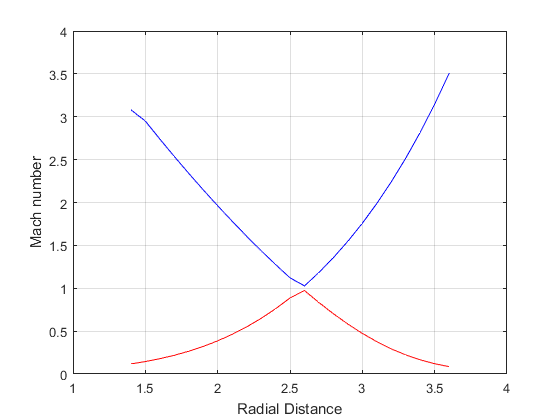
**Assignment - 2**

**An Astrophysical Inflow**

In the problem of spherically symmetric astrophysical accretion, interstellar ﬂuid matter (a very thin gas) travels a great distance (almost from inﬁnity) along radial lines and falls on to a massive star (or a neutron star or even a black hole) located at the origin of coordinates. The star can be treated as a point-like particle, and the rate of the ﬂuid ﬂow (matter ﬂowing in unit time) on to it is given as

in which G is Newton’s universal gravitational constant, M is the mass of the central astrophysical object, ρ∞ is the constant density of the gas at inﬁnity, cs(∞) is the speed of sound at inﬁnity, and γ is a dimensionless number called the polytropic exponent (1 ≤ γ ≤ 5/3). The velocity of the ﬂuid ﬂow v, as a function of the radial distance from the centre r, is given by the equation

Solve Eq.(1) by the bisection method to ﬁnd v(r), using the values M = 2 × 1030 kg, cs(∞) = 10 km s−1, ρ∞ = 10−21 kg m−3 and n = 2.5. These values are typical of accretion of the interstellar medium on to a star. Each value of r in Eq.(1) will give a set of two real and physical roots of v. The plot of v(r) is shown in Fig. 1, in which v is scaled as the Mach number, v(r)/cs(r). Obtain a similar plot.



**Assignment - 3**

**A Nuclear Outflow**

High-energy impacts and collisions among elementary particles can result in an outflow of nuclear fluid. The rescaled equations of the steady outflow are,

xyR^2 = 1 , (2) y^2 + 3x^2 − 4x = B, (3)

the velocity of an acoustic wave in the nuclear matter is u 2 = x(3x − 2). On the same graph now plot R versus u.