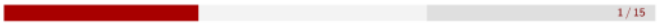
Printout

Monday, September 23, 2024 2:03 PM

int
~~float~~ sensorValue = analogRead(A0);
float voltage = ~~(sensorValue/1023)~~ * 5.0;
sensorValue * 5.0/1023;

Section 1

MANE 3351



ecture 8

lassroom Management

genda

- Part 2: Bisection Search lecture
- Test 1

esources

andouts

- Lecture 8 Slides
- Lecture 8 Marked Slides
- Test 1 - Fall 2023

ssignments

- Homework 1 (assigned 9/16/2024, due 9/23/2024 (before 11:59 pm)
- Homework 2 (assigned 9/18/2024, due 9/25/2024 (before 11:59 pm - no late submissions)
- Lab 3 (assigned 9/18/2024, due 9/25/2024 (before 2:00pm))
- Read textbook pages 41-46

chedule

ecture/Lab	Date	Topic
	9/23	Roots of Equations, bisection method (not on Test 1)
	9/25	Bisection Method Error Analysis, False Position (not o
)	9/30	Test 1 (lectures 1-7)

oots of Equations

ıtroduction

- Value x such that $f(x)=0$
- Extremely useful operations
- Engineering Economic Examples
  - Break-even analysis
  - Payback period
  - Rate of return

uadratic Equation

onsider a second-order polynomial $ax^2 + bx + c = 0$

- The quadratic formula finds the value(s) of x

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$x^2 - 4x - 5 = 0$

$(x - 5)(x + 1)$

$x = 0$ $\quad$ $x = -1$

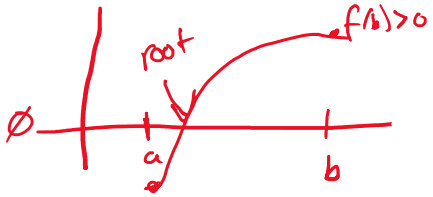
oot Bracketing Techniques

- Many techniques for find roots start by bracketing the root
- Consider the cumulative distribution function (CDF) of a standard normal distribution

$$\text{Find } f(x) = \Phi(z) = \int_{-\infty}^{z} \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}u^2\right) du$$

- Goal: Find first quartile that is the value of z such that $\Phi(z) = 0.25$
- Start up writing equation
- Trial and error
- Python can help

$\Phi(z) - .25 = 0$



$f(a) < 0$,

Smooth, continuous fnc

tatistical Functions in Python

- General Statistical Functions
- Normal Distribution

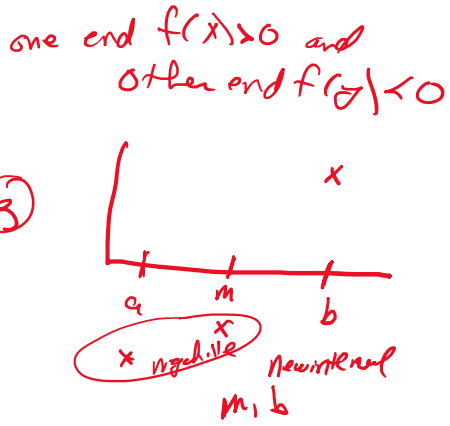
ython Code for Statistical Functions

```
rom scipy import stats
=0.25

=float(input("Enter the value of x: "))
x=stats.norm.cdf(x)

rint("for x={}, f({})={}".format(x,x,fx))

rint("{}-th percentile={}".format(p,stats.norm.ppf(p)))
```

isection Method

1. Identify an interval *[a,b]* such that either *a* or *b* overshoots the mark while the other undershoots it.
2. Calculate the midpoint, *m*, of the identified interval
3. If *a* and *m* both overshoot or both undershoot the mark, the desired value lies in *[m,b]*
4. If *b* and *m* both overshoots or both undershoot the mark, the desired value lies in *[a,m]*
5. Return to step 2 using the newly identified interval

ource: textbook, page 41



imple Pseudocode

Step 1: Set $L = f(a)$;
Step 2: Set $m = \frac{a+b}{2}$; $M = f(m)$;
Step 3: If $LM < 0$ then set $b = m$; else set $a = m$ and $L = M$;
Step 4: Go to Step 2.

ource: textbook, page 43

```
from scipy import stats
ef f(x):
   return stats.norm.cdf(x)-.25
 initialize code
=-0.9
=0.9
=1
=f(a)
=(a+b)/2.0 # discuss divisor
=f(m)
hile True:
   if L*M<0.0:
       b=m
   else:
       a=m
       L=M
   m=(a+b)/2.0
```

seudocode 2

Assumptions: f is continuous on $[a,b]$. $f(a)$ and $f(b)$ have opposite signs.
Input: Interval $[a,b]$; function f; desired accuracy tol.
Step 1: Set $N = \left\lceil \frac{\ln(b-a)-\ln(tol)}{\ln 2} \right\rceil$; $L = f(a)$;
Step 2: For $j = 1 \ldots N$ do Steps 3-5:
  Step 3: Set $m = \frac{a+b}{2}$; $M = f(m)$;
  Step 4: If $M = 0$ then return m;
  Step 5: If $LM < 0$ then set $b = m$; else set $a = m$ and $L = M$;
Output: Approximation m within tol of exact root or message of failure.

ource: textbook, page 43

ceiling → roundup

Programming No-no

M < tol

```
 Pseudo-code 2
rom scipy import stats
nport math
ef f(x):
   return stats.norm.cdf(x)-.25
 initialize code
=-3.0
=0.0
ol=0.0005
=100
rr=math.fabs(b-a)
=f(a)
or i in range(0,N+1):
   m=(a+b)/2.0
   M=f(m)
   err=err/2.0
   if (M==0) or (err<tol):
```

oftware

- It should be apparent that having software to follow the lectures is very helpful
  - Instructions for installing Anaconda Python
  - Instructions for creating Conda Environment