Lecture 4II

- fzero
- Multiple roots

Inline Function

```
fstr='x.^2-2*x-4';
fx=inline(fstr)
```

Function evaluation

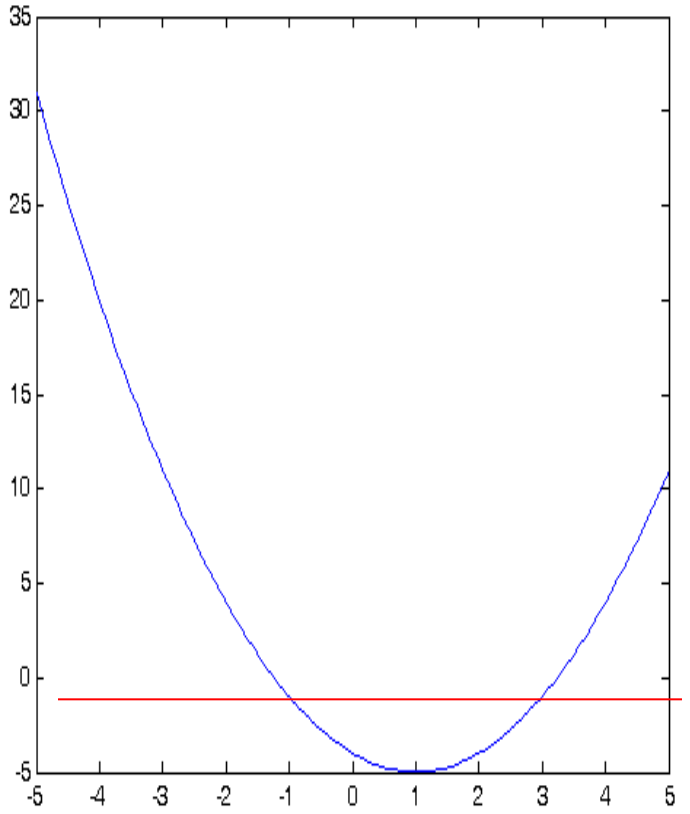
```
fstr='x.^2-2*x-4';
fx=inline(fstr)
```

```
x = -5:1:5;
y = fx(x)
```

```
y = [ 31    20    11     4    -1    -4    -5    -4    -1     4    11]
```

Plot

```
>> fstr='x.^2-2*x-4';
>> fx=inline(fstr);
>> x=linspace(-5,5);
>> plot(x,fx(x));
```



Find zeros

```
>> fstr = 'x.^2-2*x-4';
>> v = fzero(fstr,1)

ans =

   -1.2361
```

```
fx(v)

ans =

     0
```

fzero

- fzero(fstr,x0)
- Input
  - A string that expresses a 1D function
  - Initial guess
- Output
  - A root

Multiple roots

- Find multiple roots of a given function

- Different guesses may lead to different roots

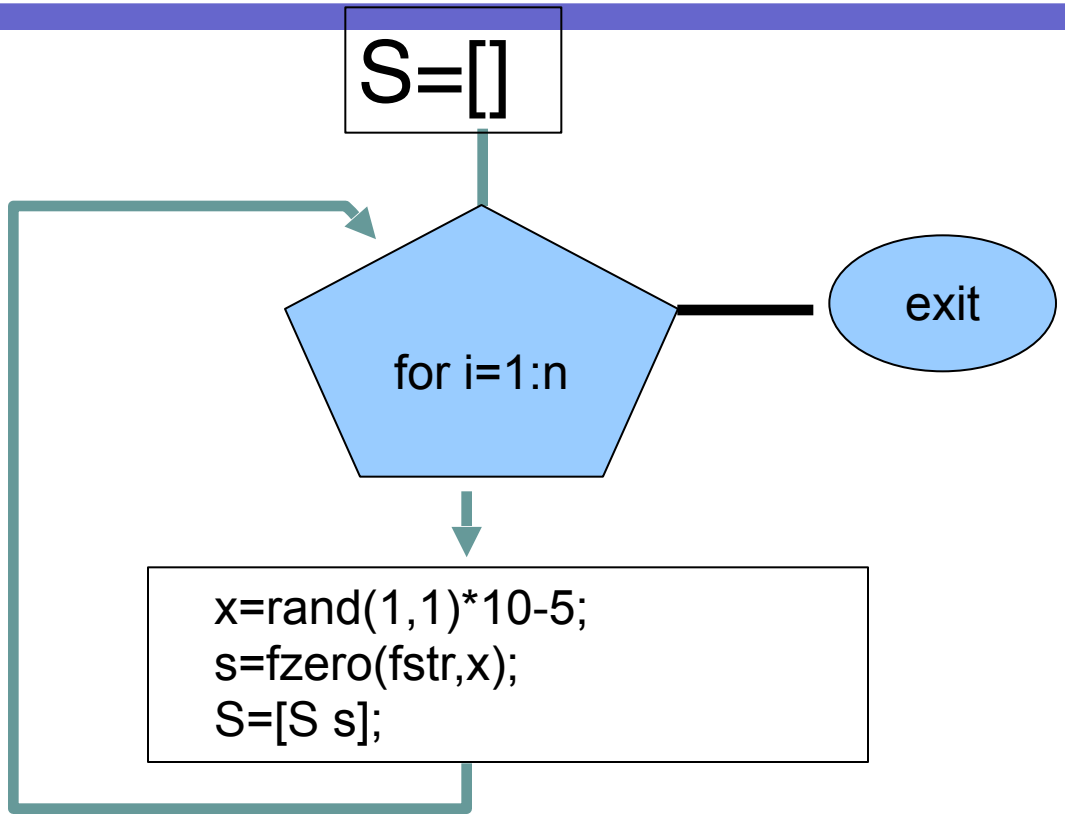
```
>> fstr = 'x.^2-2*x-4';
>> v = fzero(fstr,1)

ans =

   -1.2361
```

```
fx(v)

ans =

     0
```

```
>> v = fzero(fstr,5)

v =

    3.2361
```

```
fx(v)

ans =

     0
```

Flow chart I



- Let s be a root and S store distinct roots
- Check

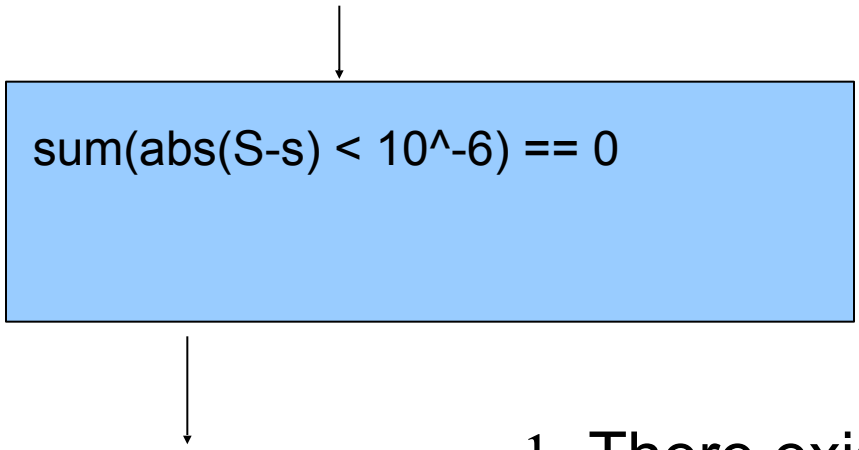
$$\text{sum}(\text{abs}(S-s) < 10^{-6}) == 0$$

1. Absolute differences between s and elements in S
2. Check if any absolute difference is less than a small positive value
3. Exist -> left hand side greater zero -> logical value is 0
4. Not exist -> left hand side equals zero -> logical value is 1

Case I

S=[1 2 3]; s=1

It is FALSE to say s not in S



ans =

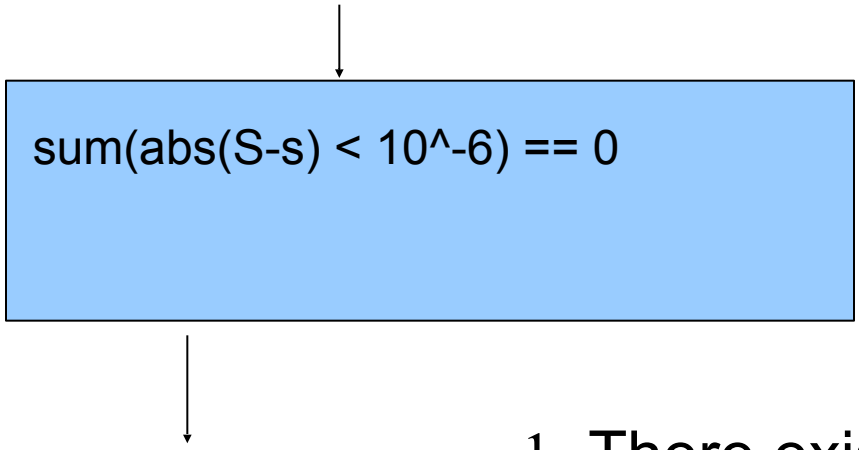
0

1. There exists some element in S close enough to s
2. s belongs S

Case II

S=[1 2 3]; s=1+eps

It is FALSE to say s not in S



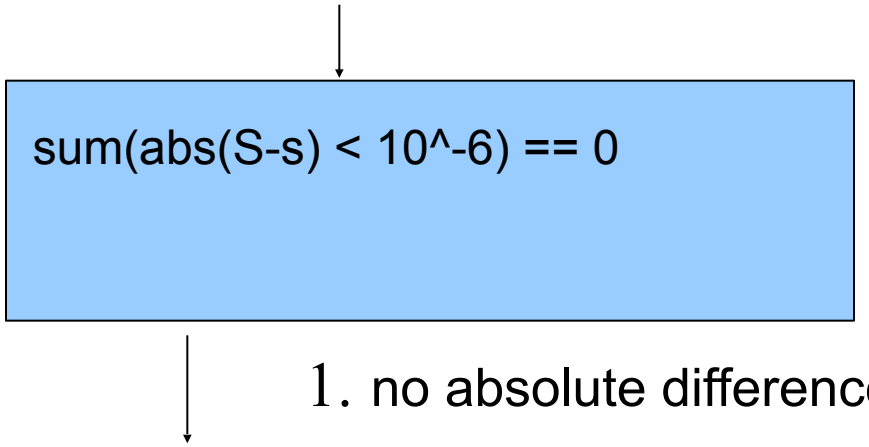
ans =

0

1. There exists some element in S close enough to s
2. s belongs S

Case III

S=[1 2 3]; s=1.5



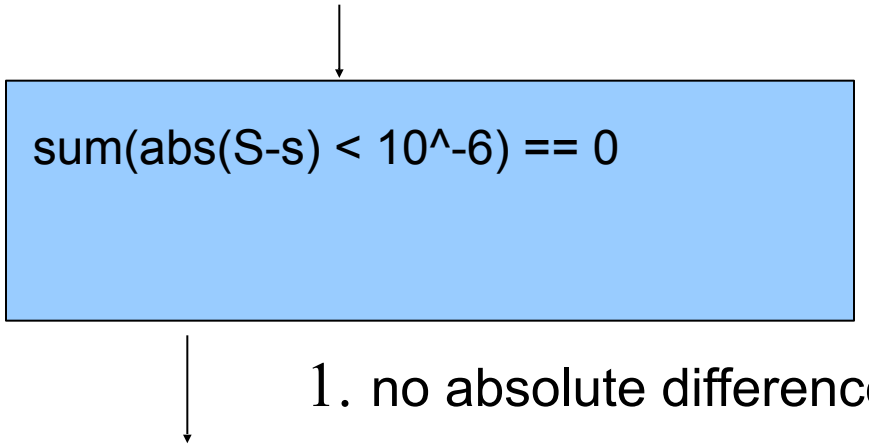
ans =

1

1. no absolute difference less than 10^-6
2. there exists no element in S close enough to s
3. s does not belong S
4. It is TRUE to say s not in S

Case IV

S=[]; s=1.5

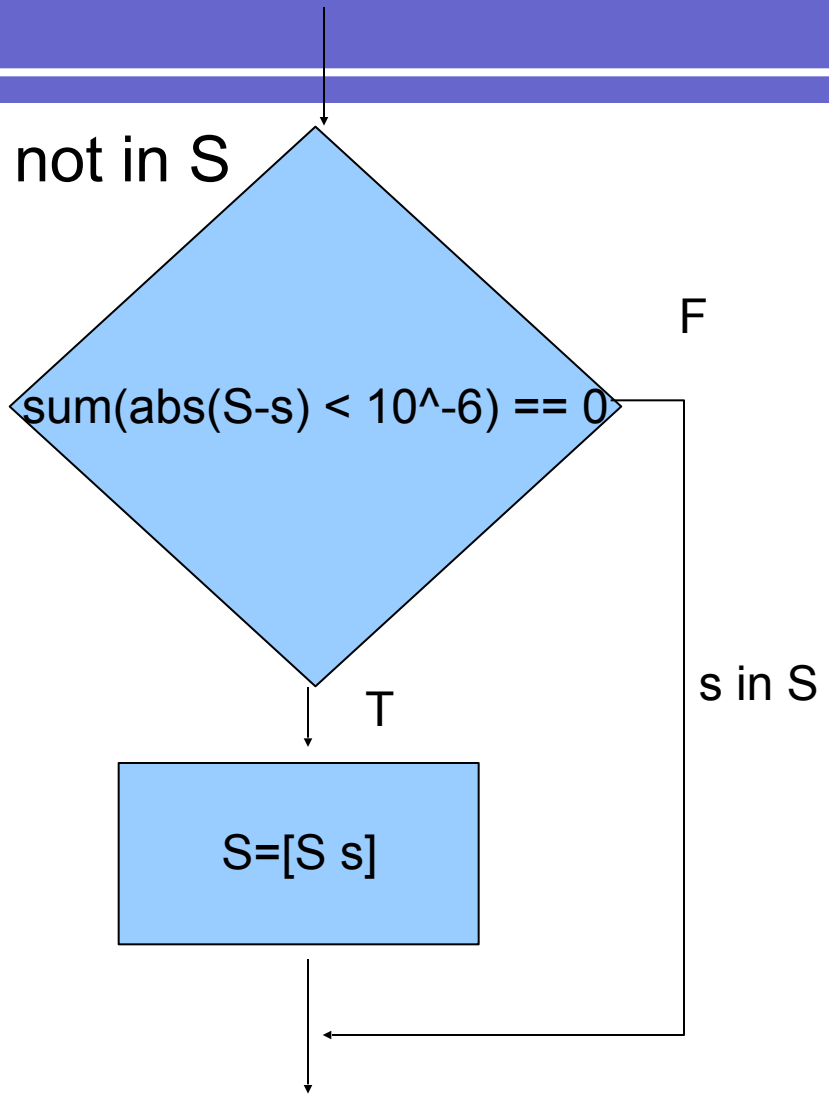


ans =

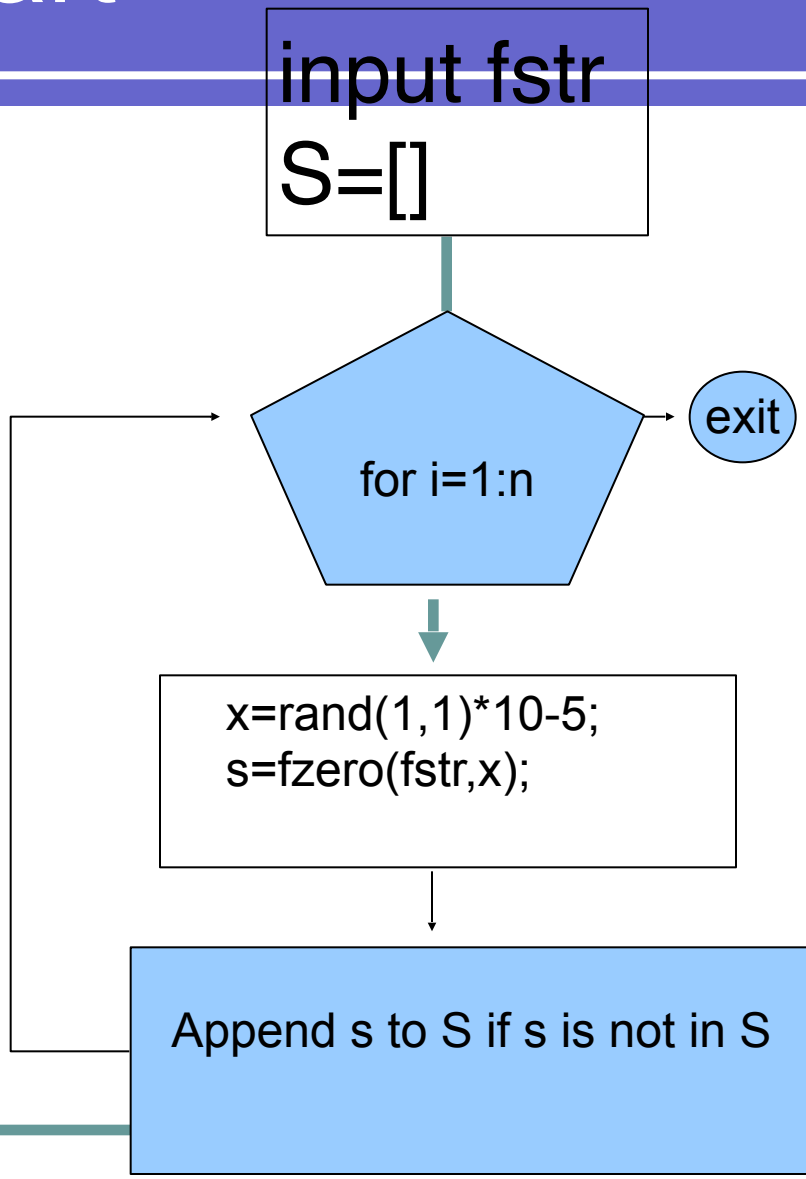
1

1. no absolute difference less than 10^-6
2. there exists no element in S close enough to s
3. s does not belong S
4. It is TRUE to say s not in S

Append s to S if s is not in S



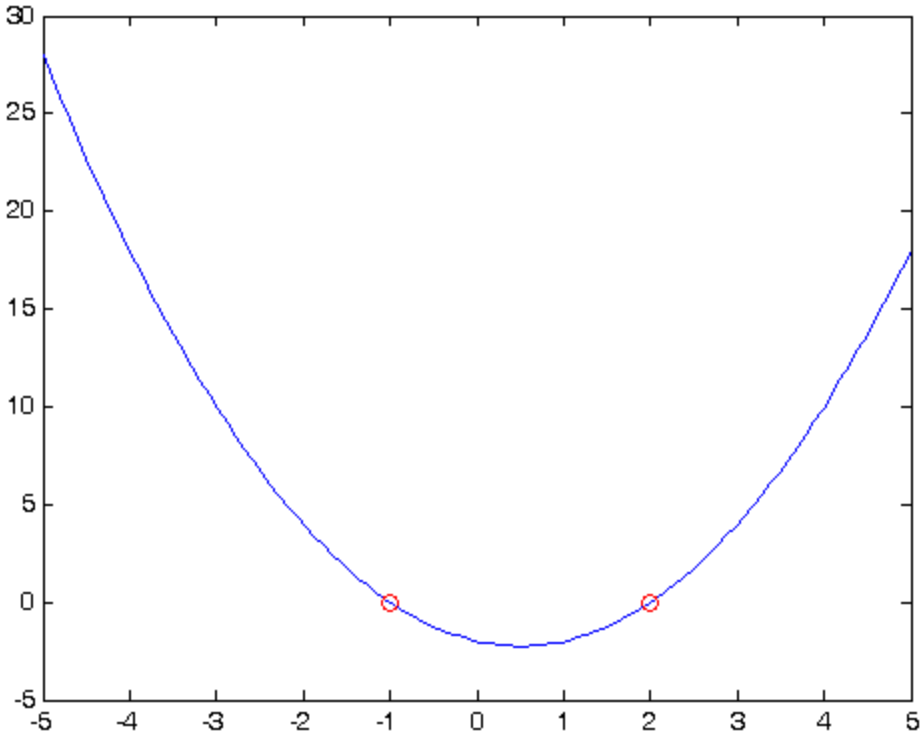
Flow chart


input fstr
S=[]
for i=1:n
exit
x=rand(1,1)*10-5;
s=fzero(fstr,x);
Append s to S if s is not in S

Multiple roots

source codes

```
fstr=input('key in a function:','s');
S=[];
ep=10^-6;
for i=1:10
    x=rand(1,1)*8-4;
    s=fzero(fstr,x);
    if  sum(abs(S-s) < 10^-6) == 0
        S=[S s];
    end
end
S
fx=inline(fstr);
x=linspace(-5,5);
plot(x,fx(x));hold on;
plot(S,zeros(size(S)),'ro');
```


30
25
20
15
10
5
0
-5
-5
-4
-3
-2
-1
0
1
2
3
4
5