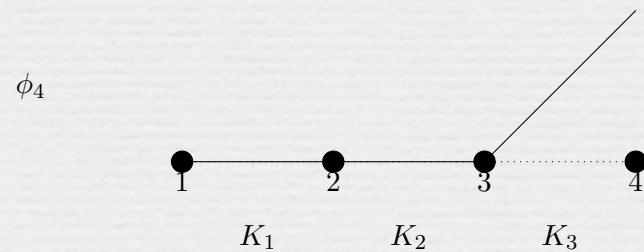
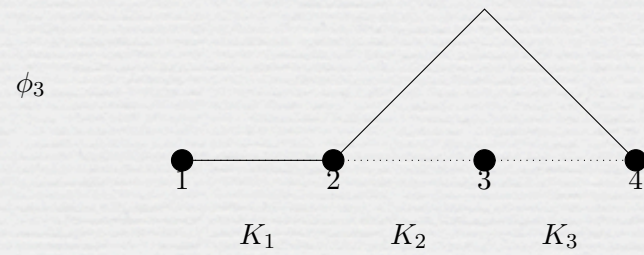
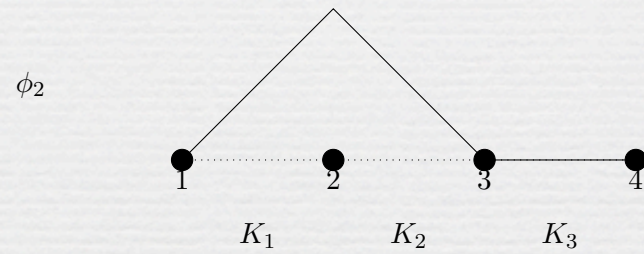
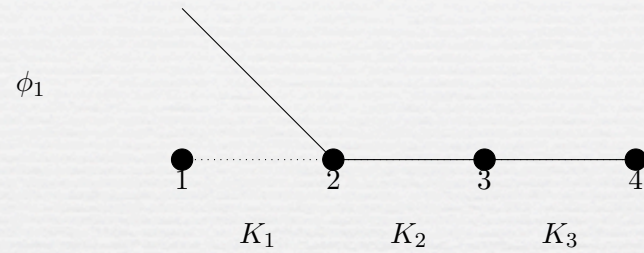


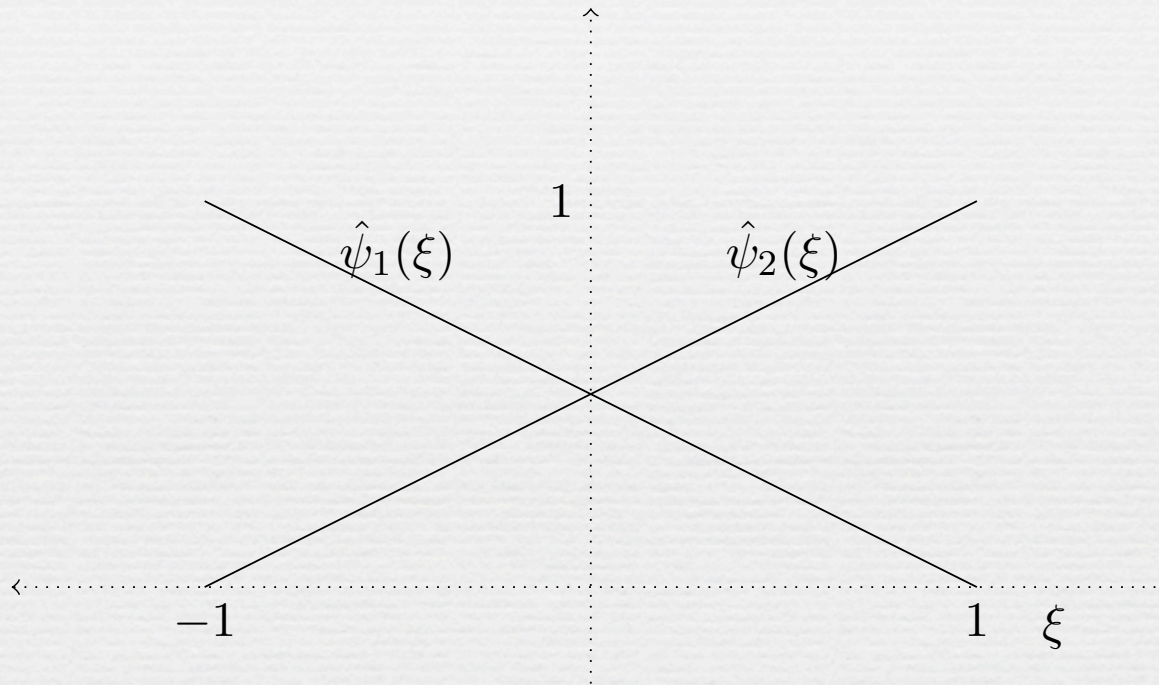
FEM: notes

HOMs Class
Amik St-Cyr

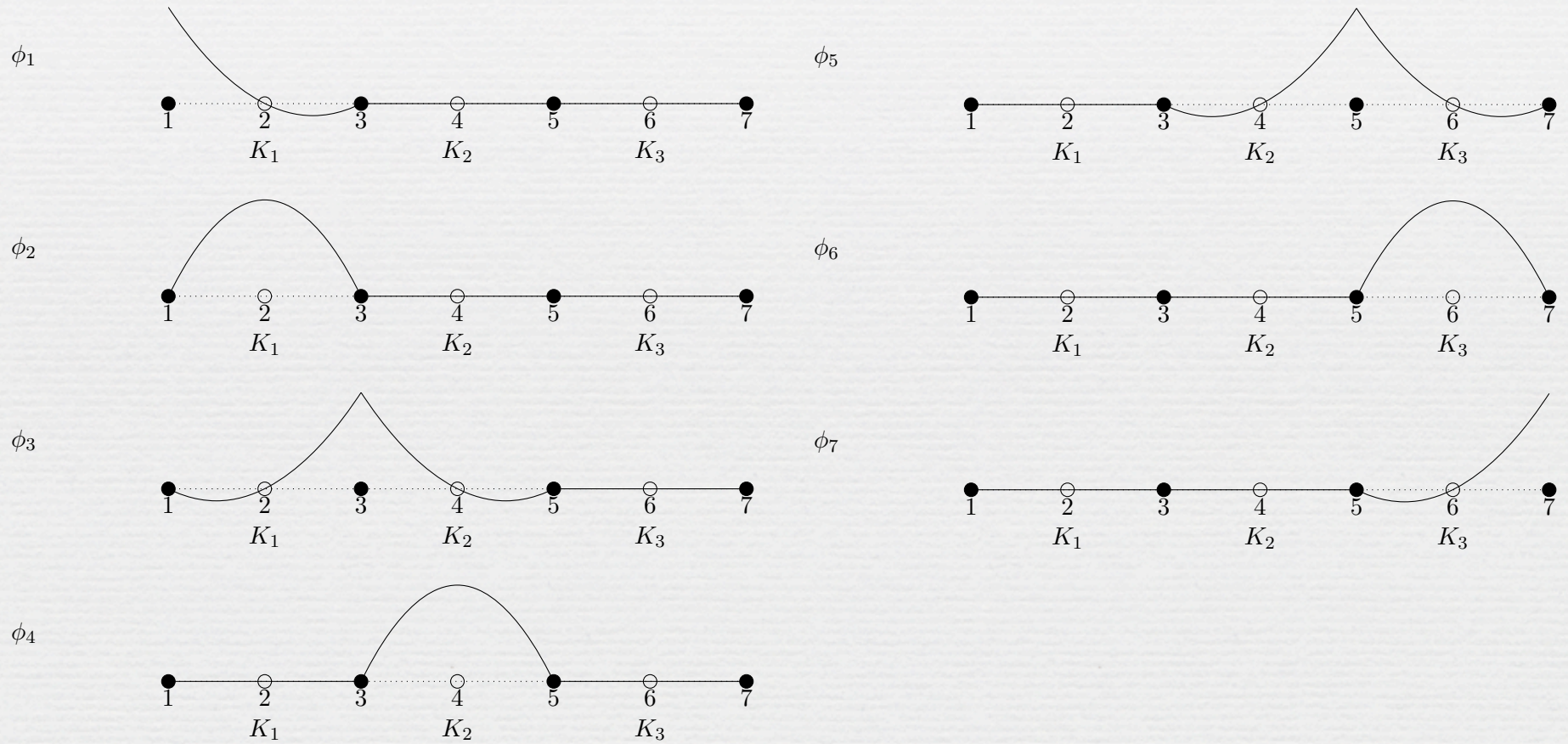
Ritz linear functions:



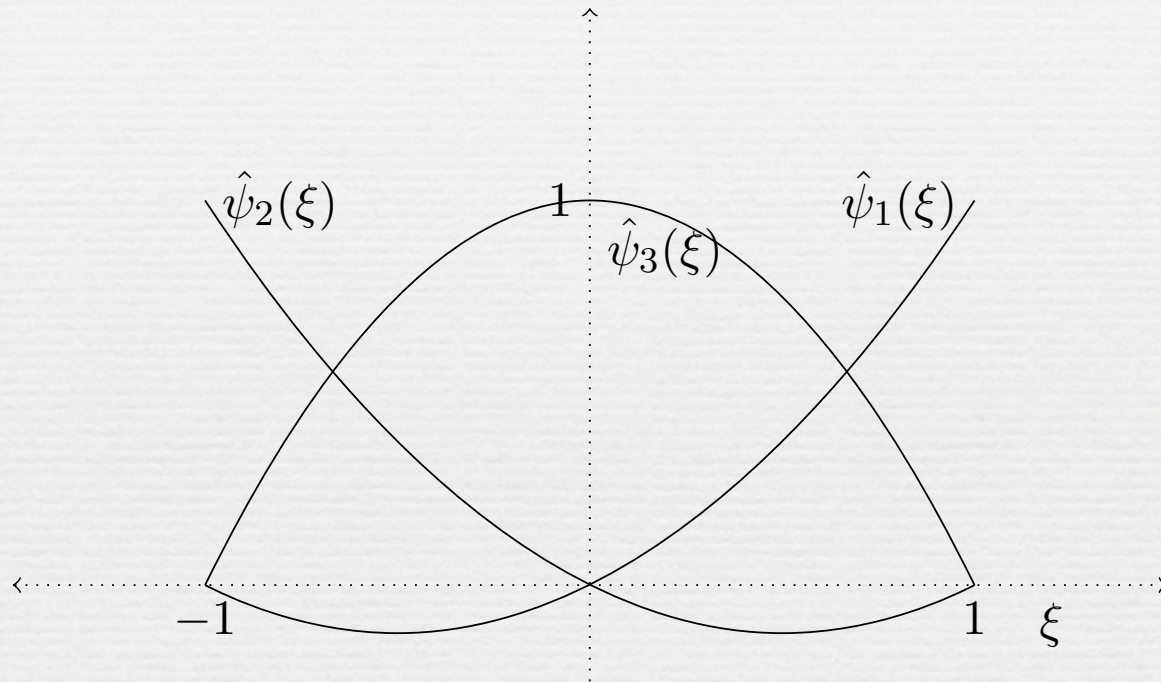
On a single element:



Ritz quadratic functions:



On a single element:



Matlab example:

```
% Elemental Mass matrix 1D
```

```
Mhat1D = [2/3 1/3;1/3 2/3];
```

```
% Elemental Stiffness matrix 1D
```

```
Khat1D = [1/2 -1/2;-1/2 1/2];
```

```
M = zeros(n,n);
```

```
K = zeros(n,n);
```

```
% Assembly
```

```
for i=1:n-1
```

```
    h = x(i+1) -x(i);
```

```
    M(i:i+1,i:i+1) = M(i:i+1,i:i+1) + 0.5*h*Mhat1D(:,:);
```

```
    K(i:i+1,i:i+1) = K(i:i+1,i:i+1) + (2/h)*Khat1D(:,:);
```

```
end
```

Matlab example:

```
%  
% Solve the problem  
%  
%  $u - \Delta u = f$   
%  
% Dirichlet  $u(-1)=u(1)=1$   
%  
  
f = 1 + 2*sin(x);  
f = Operators.M1DQ1*f';  
  
A = Operators.M1DQ1 + Operators.K1DQ1;  
  
% Impose boundary  
% conditions:  
  
u = zeros(N,1);  
u(1) = 1;  
u(N) = 1;  
f = f-A*u;  
  
% Solve for interior homogeneous block:  
u(2:N-1,1) = A(2:N-1,2:N-1)\f(2:N-1);  
  
% Plot and compute error  
plot(x,u)  
norm(u - 1 - sin(x'))
```

Homework:

- ❧ Goto www.image.ucar.edu/staff/amik
- ❧ Download homework for HOMs class (day 1).
- ❧ Construct and compare Q1 and Q2 FEM.