Solution 23.19

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%  Finite Difference Approximation of slope
%  For f(x)=exp(-2*x)-x
%      f'(x)=-2*exp(-2*x)-1
%  Centered diff. df/dx=(f(i+1)-f(i-1))/2dx         + O(dx^2)
%  Fwd. diff.     df/dx=(-f(i+2)+4f(i+1)-3f(i))/2dx + O(dx^2)
%  Bkwd. diff.    df/dx=(3f(i)-4f(i-1)+f(i-2))/2dx  + O(dx^2)
x=2;
fx=exp(-2*x)-x;
dfdx2=-2*exp(-2*x)-1;
%approximation
dx=0.5:-0.01:.01;
for i=1:length(dx)
  %x-values at i+-dx and +-2dx
  xp(i)=x+dx(i);
  x2p(i)=x+2*dx(i);
  xn(i)=x-dx(i);
  x2n(i)=x-2*dx(i);
  %f(x)-values at i+-dx and +-2dx
  fp(i)=exp(-2*xp(i))-xp(i);
  f2p(i)=exp(-2*x2p(i))-x2p(i);
  fn(i)=exp(-2*xn(i))-xn(i);
  f2n(i)=exp(-2*x2n(i))-x2n(i);
  %Finite Diff. Approximations
  Cdfdx(i)=(fp(i)-fn(i))/(2*dx(i));
  Fdfdx(i)=(-f2p(i)+4*fp(i)-3*fx)/(2*dx(i));
  Bdfdx(i)=(3*fx-4*fn(i)+f2n(i))/(2*dx(i));
end
dx0=0;
plot(dx,Fdfdx,'--',dx,Bdfdx,'-.',dx,Cdfdx,'-',dx0,dfdx2,'*')
grid
title('Forward, Backward, and Centered Finite Difference approximation - 2nd
Order Correct')
xlabel('Delta x')
ylabel('df/dx')
gtext('Centered'); gtext('Forward');  gtext('Backward')
```

Solution continued on the next page...