first solution has the output in a cell array:

```
>> syms x y R
>> [xc,yc]=solve('(x-2)^2+(y-4)^2=R^2','y=x/2+1')
xc =
((4*R^2)/5 - 64/25)^(1/2) + 14/5
 14/5 - ((4*R^2)/5 - 64/25)^(1/2)
yc =
((4*R^2)/5 - 64/25)^(1/2)/2 + 12/5
 12/5 - ((4*R^2)/5 - 64/25)^(1/2)/2
```

The two equations are typed in the `solve` command.

Output in a cell array.

Output in a cell array with two cells named `xc` and `yc`. Each cell contains two solutions in a symbolic column vector.

The second solution has the output in a structure:

```
>> COORD=solve('(x-2)^2+(y-4)^2=R^2','y = x/2+1')
COORD =
    x: [2x1 sym]
    y: [2x1 sym]
>> COORD.x
ans =
((4*R^2)/5 - 64/25)^(1/2) + 14/5
14/5 - ((4*R^2)/5 - 64/25)^(1/2)
>> COORD.y
ans =
((4*R^2)/5 - 64/25)^(1/2)/2 + 12/5
12/5 - ((4*R^2)/5 - 64/25)^(1/2)/2
```

Output in a structure.

Output in a structure named `COORD` that has two fields, `x` and `y`. Each field is a 2 by 1 symbolic vector.

Type the address of the field `x`.

The content of the field (the solution for x) is displayed.

Type the address of the field `y`.

The content of the field (the solution for y) is displayed.

11.4 DIFFERENTIATION

Symbolic differentiation can be carried out by using the `diff` command. The form of the command is:

`diff(S)` or `diff(S,var)`

- Either `S` can be the name of a previously created symbolic expression, or an expression can be typed in for `S`.
- In the `diff(S)` command, if the expression contains one symbolic variable, the differentiation is carried out with respect to that variable. If the expression contains more than one variable, the differentiation is carried out with respect to the default symbolic variable (Section 11.1.3).

- In the `diff(S,var)` command (which is used for differentiation of expressions with several symbolic variables) the differentiation is carried out with respect to the variable `var`.
- The second or higher (nth) derivative can be determined with the `diff(S,n)` or `diff(S,var,n)` command, where `n` is a positive number. $n = 2$ for the second derivative, $n = 3$ for the third, and so on.

Some examples are:

```
>> syms x y t
>> S=exp(x^4);
>> diff(S)
ans =
4*x^3*exp(x^4)
>> diff((1-4*x)^3)
ans =
-12*(1-4*x)^2
>> R=5*y^2*cos(3*t);
>> diff(R)
ans =
10*y*cos(3*t)
>> diff(R,t)
ans =
-15*y^2*sin(3*t)
>> diff(S,2)
ans =
12*x^2*exp(x^4)+16*x^6*exp(x^4)
```

Define `x`, `y`, and `t` as symbolic variables.

Assign to `S` the expression e^{x^4}.

Use the `diff(S)` command to differentiate `S`.

The answer $4x^3e^{x^4}$ is displayed.

Use the `diff(S)` command to differentiate $(1-4x)^3$.

The answer $-12(1-4x)^3$ is displayed.

Assign to `R` the expression $5y^2\cos(3t)$.

Use the `diff(R)` command to differentiate `R`.

MATLAB differentiates `R` with respect to y (default symbolic variable); the answer $10y\cos(3t)$ is displayed.

Use the `diff(R,t)` command to differentiate `R` w.r.t. t.

The answer $-15y^2\sin(3t)$ is displayed.

Use `diff(S,2)` command to obtain the second derivative of `S`.

The answer $12x^2e^{x^4} + 16x^6e^{x^4}$ is displayed.

- It is also possible to use the `diff` command by typing the expression to be differentiated as a string directly in the command without having the variables in the expression first created as symbolic objects. However, the variables in the differentiated expression do not exist as independent symbolic objects.

11.5 INTEGRATION

Symbolic integration can be carried out by using the `int` command. The command can be used for determining indefinite integrals (antiderivatives) and definite integrals. For indefinite integration the form of the command is:

`int(S)` or `int(S,var)`