# M30299 – Programming
# Lecture 09 – Defining functions – an example

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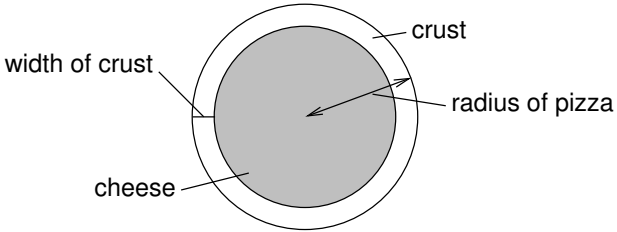
# Writing function definitions – an example

- The cost of a cheese pizza is made up of:
  - the cost of the dough base (which is 1p per $cm^2$); plus
  - the cost of the cheese topping (which is 2.5p per $cm^2$).




- Let's write a program that asks the user for:
  - the radius of the complete pizza; and
  - the width of the crust

  and displays the total cost of the pizza in pounds.

# Writing function definitions – an example

- We'll start by splitting the task into two separate functions:
  - `main` - this will ask the user for the two inputs, and display the final result (i.e. it forms a **user interface**.)
  - `costOfPizza` - this function will actually calculate the cost.
- Clearly, the `main` function will need to call `costOfPizza`; i.e. `main` will take the form:

```
get radius of pizza from user
get width of crust from user
call costOfPizza to calculate cost of pizza
      based on the radius and crust width
display cost
```

# Writing a function definition

- The `costOfPizza` function needs the pizza **radius** and crust **width** in order to calculate the cost: these will be its **parameters**.
- To give the cost the function can follow the steps:
  - cost of base $=$ 0.01 $\times$ area of base
  - cost of topping $=$ 0.025 $\times$ area of topping
  - return cost of base $+$ cost of topping
- We could therefore write:

```
def costOfPizza(radius, width):
    costBase = 0.01 * math.pi * radius ** 2
    costTop = 0.025 * math.pi * (radius - width) ** 2
    return costBase + costTop
```

# Writing a function definition

- However, there is repetition here (in the calculation of areas).
- A better solution would be to use a further function that will find areas of circles for us:

```
def area(radius):
    return math.pi * radius ** 2

def costOfPizza(radius, width):
    costBase = 0.01 * area(radius)
    costTop = 0.025 * area(radius - width)
    return costBase + costTop
```

- Could this code be improved further?

# Writing a function definition

- The `main` function is relatively simple to write

```
def main():
    base = int(input("Pizza radius: "))
    crust = int(input("Crust width: "))
    cost = costOfPizza(base, crust)
    print("Cost {0:0.2f}".format(cost))
```

# Operation of function calls

```
def area(radius):
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def costOfPizza(radius, width):
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| | |
|---|---|
| base | 10 |
| crust | 3 |

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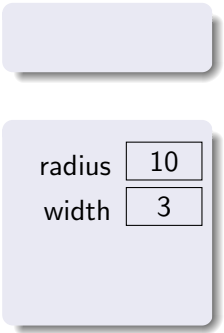

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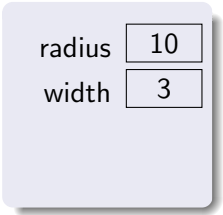


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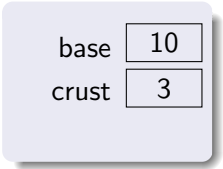

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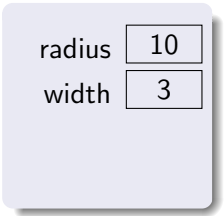


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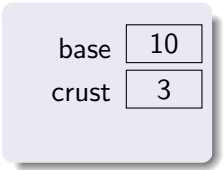

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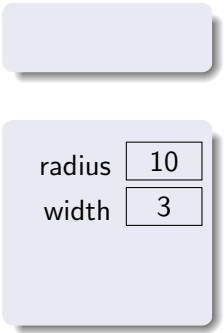

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    return costBase + costTop
```

| | |
|---|---|
| radius | 10 |
| width | 3 |
| costBase | 3.14 |

```
def main():
    base = int(input("Pizza radius: "))
    crust = int(input("Crust width: "))
    cost = costOfPizza(base, crust)
    print("Cost {0:0.2f}".format(cost))
```

| | |
|---|---|
| base | 10 |
| crust | 3 |

# Operation of function calls

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def area(radius):
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| radius | 10 |
| width | 3 |
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def main():
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    cost = costOfPizza(base, crust)
    print("Cost {0:0.2f}".format(cost))
```

| | |
|---|---|
| base | 10 |
| crust | 3 |

# Operation of function calls

```
def area(radius):
    return math.pi * radius ** 2
```

| radius | 7 |
|---|---|

```
def costOfPizza(radius, width):
    costBase = 0.01 * area(radius)
    costTop = 0.025 * area(radius - width)
    return costBase + costTop
```

| radius | 10 |
|---|---|
| width | 3 |
| costBase | 3.14 |

```
def main():
    base = int(input("Pizza radius: "))
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    cost = costOfPizza(base, crust)
    print("Cost {0:0.2f}".format(cost))
```

| base | 10 |
|---|---|
| crust | 3 |

# Operation of function calls

```
def area(radius):
>    return math.pi * radius ** 2
```

| radius | 7 |
|---|---|

```
def costOfPizza(radius, width):
    costBase = 0.01 * area(radius)
    costTop = 0.025 * area(radius - width)
    return costBase + costTop
```

| radius | 10 |
|---|---|
| width | 3 |
| costBase | 3.14 |

```
def main():
    base = int(input("Pizza radius: "))
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```

| base | 10 |
|---|---|
| crust | 3 |

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def area(radius):
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def costOfPizza(radius, width):
    costBase = 0.01 * area(radius)
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```

| | |
|---|---|
| radius | 10 |
| width | 3 |
| costBase | 3.14 |

```
def main():
    base = int(input("Pizza radius: "))
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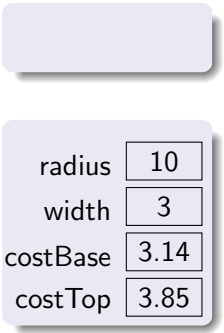

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    print("Cost {0:0.2f}".format(cost))
```

| | |
|---|---|
| radius | 10 |
| width | 3 |
| costBase | 3.14 |
| costTop | 3.85 |

| | |
|---|---|
| base | 10 |
| crust | 3 |

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```

| | |
|---|---|
| base | 10 |
| crust | 3 |
| cost | 6.99 |

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```

| | |
|---|---|
| base | 10 |
| crust | 3 |
| cost | 6.99 |