Configuration

Design & Creativity
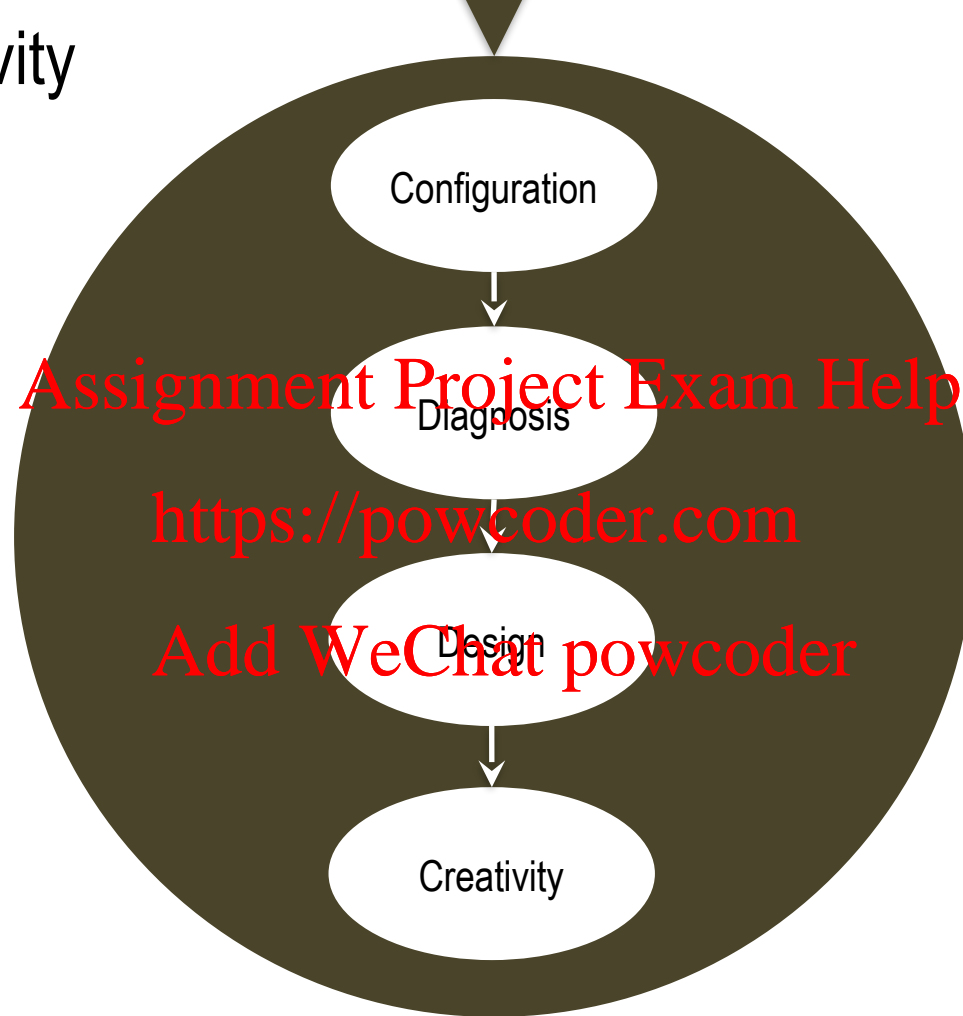
Lesson Preview

- Design & configuration

- Plan refinement

- Connections to earlier topics

Requirements:

- Total area must equal sum of areas of individual rooms.
- All rooms must be rectangular.
- Utility closet and stairwell must each be at least 100 square feet.
- No length or width can be under 10 feet.

- Length is 44, width is 30.
- Bathroom must be at least 200 square feet.
- Two other rooms, each at least 400 square feet.

```
Basement
    height : 8
    total-width : 30
    total-length : 44
    util-closet-width : 10
    util-closet-
length : 10
    stairwell-width : 10
    stairwell-length : 10
    bathroom-width : 20
    bathroom-length :
    rooms :
```

```
Room                    Room
                            20                        20
length : 23             length : 23
        width               width
```
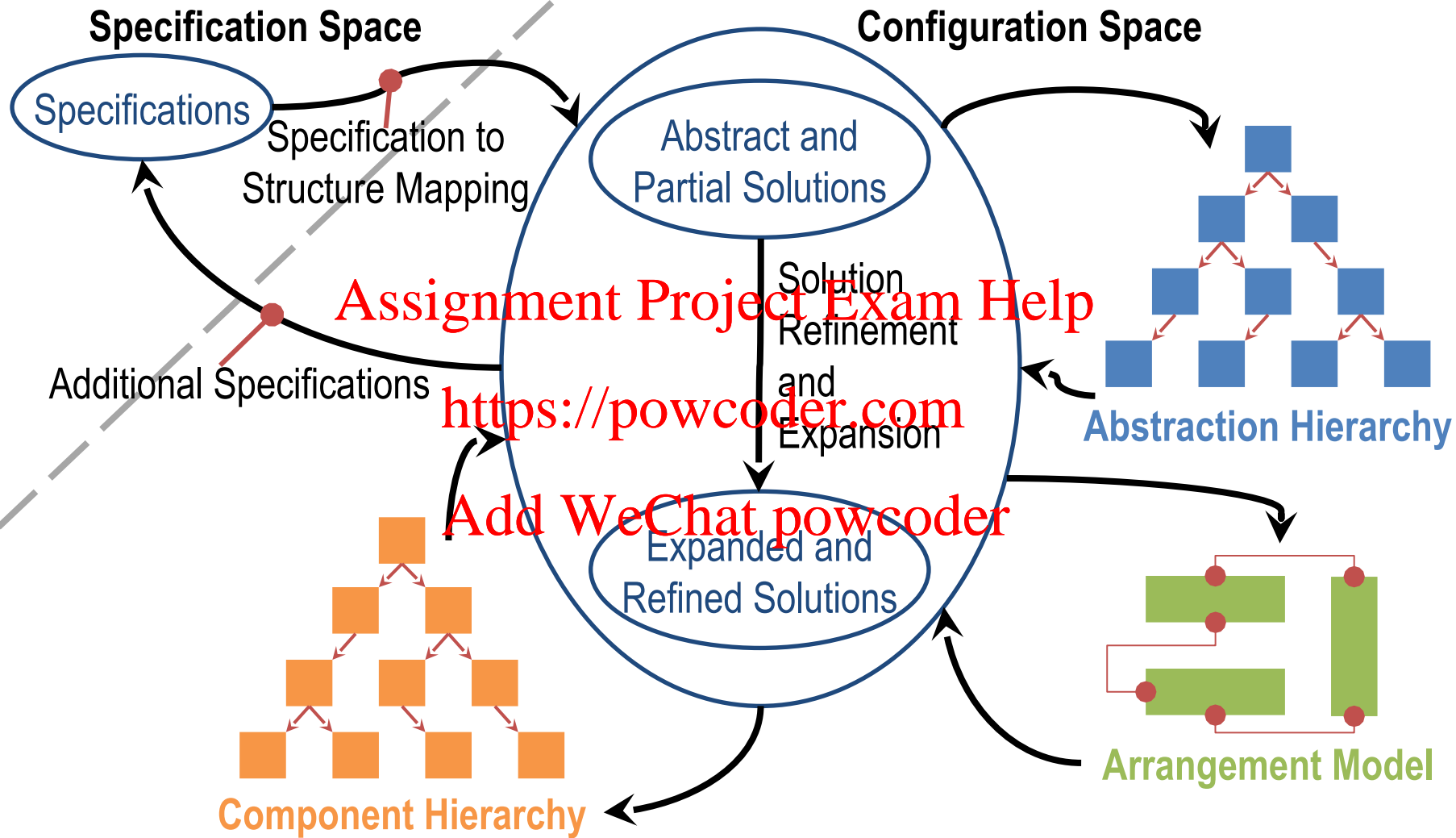
Configuration: A problem-solving activity that assigns values to variables to satisfy constraints.

Specification Space

Specifications

Specification to Structure Mapping

Additional Specifications

Configuration Space

Abstract and Partial Solutions

Solution Refinement and Expansion

Expanded and Refined Solutions

Abstraction Hierarchy

Arrangement Model

Component Hierarchy

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```
Chair

        mass :
        cost :
        legs :
        seat :
        arms :
        back :
```

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Chair

mass :

cost :

legs :

seat :

arms :

back :

Chair Legs

count :

size :

material :

cost :

Chair Seat

size :

material :

cost :

Chair Arms

size :

material :

cost :

Chair Back

size :

material :

cost :

Chair

mass :
cost :
legs :
seat :
arms :
back :

Chair Legs
count : {3, 4, 5}
size : {5 – 50g}
material : {}
cost :

Chair Seat
size : {10 – 100g}
material : {}
cost :

Chair Arms
size : {0 – 50g}
material : {}
cost :

Chair Back
size : {10 – 100g}
material : {}
cost :

Chair

mass :
cost :
legs :
seat :
arms :
back :

Chair Legs
count : {3, 4, 5}
size : {5 - 50g}
material : {}
cost :

Chair Seat
size : {10 - 100g}
material : {}
cost :

Chair Arms
size : {0 - 50g}
material : {}
cost :

Chair Back
size : {10 - 100g}
material : {}
cost :

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Order:
A chair that weighs over 200g, costs at most $20 to make, and has 4 legs.

```
Chair
        mass :
        cost :
        legs :
        seat :
        arms :
        back :
```

```
Chair Legs
        count : {3, 4, 5}
        size : {5 – 50g}
        material : {}
        cost :
```

```
Chair Seat
        size : {10 – 100g}
        material : {}
        cost :
```

```
Chair Arms
        size : {0 – 50g}
        material : {}
        cost :
```

```
Chair Back
        size : {10 – 100g}
        material : {}
        cost :
```

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Order:

A chair that weighs over 200g, costs at most $20 to make, and has 4 legs.

Chair

mass :>200g

cost : $≤20

legs :

seat :

arms :

back :

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Chair Legs
count : **4**
size : {5 – 50g}

material : {}
cost :

Chair Seat
size : {10 – 100g}

material : {}
cost :

Chair Arms
size : {0 – 50g}

material : {}
cost :

Chair Back
size : {10 – 100g}

material : {}
cost :

Order:
A chair that weighs over 200g, costs at most $20 to make, and has 4 legs.

Chair

mass :>200g

cost : <$20

legs :

seat :

arms :

back :

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Chair Legs
count : 4
size : {5 – 50g}

material : {}
cost : <$5

Chair Seat
size : {10 – 100g}

material : {}
cost : <$5

Chair Arms
size : {0 – 50g}

material : {}
cost : <$5

Chair Back
size : {10 – 100g}

material : {}
cost : <$5

Order:
A chair that weighs over 200g, costs at most $20 to make, and has 4 legs.

Chair

mass :>200g

cost : $20

legs :

seat :

arms :

back :

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Chair Legs
count : 4
size : 25g
material : wood
cost : $5

Chair Seat
size : {10 - 100g}
material : {}
cost : <$5

Chair Arms
size : {0 - 50g}
material : {}
cost : <$5

Chair Back
size : {10 - 100g}
material : {}
cost : <$5

Order:
A chair that weighs over 200g, costs at most $20 to make, and has 4 legs.

Chair

mass :>200g

cost : $\leq$$20

legs :

seat :

arms :

back :

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Chair Legs
count : 4
size : 25g
material : wood
cost : $5.00

Chair Seat
size : 50g
material : metal
cost : $5.00

Chair Arms
size : 50g
material : metal
cost : $5.00

Chair Back
size : 50g
material : metal
cost : $5.00

Order:

A chair that weighs over 200g, costs at most $20 to make, and has 4 legs.

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Chair

mass : **250g**

cost : **$20**

legs :

seat :

arms :

back :

Chair Legs

count : 4
size : 25g
material : wood

cost : $5.00

Chair Seat

size : 50g
material : metal

cost : $5.00

Chair Arms

size : 50g
material : metal

cost : $5.00

Chair Back

size : 50g
material : metal

cost : $5.00

Fill this order:

A chair that costs at most $16 to make and has a 100g metal seat.

Chair

mass : 160g

cost : $16

legs :

seat :

arms :

back :

Chair Legs

count : 4

size : 10g

material : metal

cost : $4.00

Chair Seat

size : 100g

material : metal

cost : $10.00

Chair Arms

size : 0g

material : N/A

cost : $0.00

Chair Back

size : 20g

material : metal

cost : $2.00

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Fill this order:

A chair that costs at most $16 to make and has a 100g metal seat.

Chair

    mass :

cost : **<$16**

legs :

seat :

arms :

back :

Chair Legs

    count : {3, 4, 5}

    size : {5 – 50g}

    material : {}

    cost :

Chair Seat

    size : 100g

    material : metal

    cost : $10.00

Chair Arms

    size : {0 – 50g}

    material : {}

    cost :

Chair Back

    size : {10 – 100g}

    material : {}

    cost :

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Fill this order:
A chair that costs at most $16 to make and has a 100g metal seat.

Chair
mass :
cost : <$16
legs :
seat :
arms :
back :

Chair Legs
count : {3, 4, 5}
size : {5 – 50g}
material : {}
cost :

Chair Seat
size : 100g
material : metal
cost : $10.00

Chair Arms
size : 0g
material : N/A
cost : $0.00

Chair Back
size : {10 – 100g}
material : {}
cost :

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Fill this order:

A chair that costs at most $16 to make and has a 100g metal seat.

Chair

mass :

cost : <$16

legs :

seat :

arms :

back :

Chair Legs
count : **4**
size : **10g**
material : **metal**
cost : **$4.00**

Chair Seat
size : **100g**
material : **metal**
cost : **$10.00**

Chair Arms
size : **0g**
material : **N/A**
cost : **$0.00**

Chair Back
size : {10 - 100g}
material : {}
cost :

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Fill this order:

A chair that costs at most $16 to make and has a 100g metal seat.

```
Chair
        mass :

cost :<$16

    legs :
    seat :
    arms :
    back :
```

Chair Legs
count : 4
size : 10g
material : metal
cost : $4.00

Chair Seat
size : 100g
material : metal
cost : $10.00

Chair Arms
size : 0g
material : N/A
cost : $0.00

Chair Back
size : 20g
material : metal
cost : $2.00

Materials Table

Material	Cost per gram
Plastic	$0.01
Wood	$0.05
Metal	$0.10

Chair

mass : 160g

cost : $16

legs :

seat :

arms :

back :

Chair Legs
count : 4
size : 10g
material : metal
cost : $4.00

Chair Seat
size : 100g
material : metal
cost : $10.00

Chair Arms
size : 0g
material : N/A
cost : $0.00

Chair Back
size : 20g
material : metal
cost : $2.00

Classification and configuration are both hierarchical.

Configuration leverages classification's notion of prototype concepts.
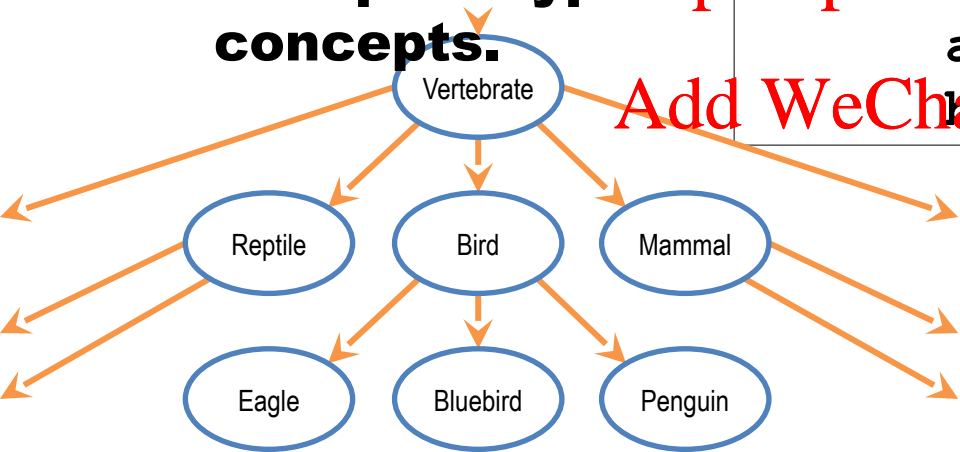
Chair

    mass : **160g**

    cost : **$16**

    legs :

    seat :

    arms :

    back :

Chair Legs

    count : 4
    size : 10g
    material : **metal**

    cost : $4.00

Chair Seat

    size : 100g
    material : **metal**

    cost : $10.00

Chair Arms

    size : 0g
    material : **N/A**

    cost : $0.00

Chair Back

    size : 20g
    material : **metal**

    cost : $2.00

Vertebrate

Reptile   Bird   Mammal

Eagle   Bluebird   Penguin

Configuration suggests starting with a prototype concept and assigning values to variables.

Chair

mass :
cost :
legs :
seat :
arms :
back :

Chair Legs
count : {3, 4, 5}
size : {5 – 50g}
material : {}
cost :

Chair Seat
size : {10 – 100g}
material : {}
cost :

Chair Arms
size : {0 – 50g}
material : {}
cost :

Chair Back
size : {10 – 100g}
material : {}
cost :

Configuration suggests starting with a prototype concept and assigning values to variables.

Case-based reasoning suggests starting from a specific chair and tweaking it as needed.

Chair

mass : 160g

cost : $16

legs :

seat :

arms :

back :

Chair Legs
count : 4
size : 10g
material : metal
cost : $4.00

Chair Seat
size : 100g
material : metal
cost : $10.00

Chair Arms
size : 0g
material : N/A
cost : $0.00

Chair Back
size : 20g
material : metal
cost : $2.00

The result of a planning task can lead to a prototype that can subsequently be configured for similar problems with differing constraints.

Chair

mass : 160g

cost : $16

legs :
seat :
arms :
back :

Chair Legs
count : 4
size : 10g
material : metal
cost : $4.00

Chair Seat
size : 100g
material : metal
cost : $10.00

Chair Arms
size : 0g
material : N/A
cost : $0.00

Chair Back
size : 20g
material : metal
cost : $2.00

<u>Assignment</u>

How would you use configuration to design an agent that could answer Raven's progressive matrices?

To recap...

- Design

- Defining configuration

- Process of configuration

- Connections to earlier topics

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