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# **Part 1 Extending and adapting the software design**

Full UML (old version) in mermaid code here in blue:

  classDiagram

    %%region UI

        namespace namesapce\_GenericUI{

            class UI1{

                %% We'll probably have to split this class up for higher cohesion.

                +void ClickRun()

                +void ClickMetrics()

                -string ReadTextBoxProgram()

                ...()

            }

            class IDataBridge{

                +void SetTextBoxProgram(string text)

                +void SetTextBoxOutput(string text)

                +string ReadTextBoxProgram()

                ...()

            }

        }

        UI1 \*-- ProgramImporter : 1 programImporter

        UI1 \*-- ExamplePrograms : 1 examplePrograms

        IDataBridge <-- UI1 : 1 dataBridge

    %%

    %%region Forms

        namespace namespace\_MSO\_P3\_Forms{

            class Form1{

            }

            class Form1.DataBridge

        }

        <<partial>> Form1

        Form1 \*-- UI1

        Form1.DataBridge \*-- Form1

        Form1.DataBridge ..|> IDataBridge

    %%

    %%region Application

        namespace namespace\_Applic{

            class Application{

                +void Run()

                #InnerProgram AskForProgram()

                #void UseProgram(InnerProgram program)

                -void Execute(InnerProgram program)

                -void GetMetrics(InnerProgram program)

            }

            class ProgramImporter{

                -string path

                -string importFromtxt(string fileName)

                -bool TryFindPath(string fileName, out StreamReader output)

                +InnerProgram ParseProgram(string fileName)

                -Body.Builder ParseCommandBody(string[] code)

            }

            class ExamplePrograms{

                +InnerProgram basic1

                +InnerProgram basic2

                +InnerProgram advanced1

                +InnerProgram advanced2

                +InnerProgram expert1

                +InnerProgram expert2

                ...

            }

        }

        Application \*-- ProgramImporter : 1 programImporter

        ProgramImporter ..> InnerProgram : creates

        Application \*-- ExamplePrograms : 1 examplePrograms

        ExamplePrograms --> InnerProgram

        ProgramMetrics <.. Application : uses

    %%

    ProgramImporter ..> Body.Builder : creates

    ExamplePrograms ..> Body.Builder : creates

    %%region Commands

        namespace namesapce\_Commands{

            class ProgramMetrics{

                +int commandCount

                +int maxNestingLevel

                +int repeatCommandCount

            }

            class Body.Builder{

                -Body.Builder AddCommand(ICommand command)

                +Body.Builder turn(Dir2 dir)

                +Body.Builder move(int stepCount)

                +Body.Builder repeat(int count, Body.Builder body)

                +Body.Builder body(Body.Builder addedBody)

                +Body Build()

            }

            class ICommand{

                +void ApplyOnWorld(ref ActualWorld world)

                +ProgramMetrics GetMetrics()

            }

            class Body

            class Bodied

            class Repeat{

                -int count

            }

            class RepeatUntil

            class If

            class ICondition{

                +Check(ActualWorld world)

            }

            class Turn{

                -Dir2 dir

            }

            class Move{

                -int stepCount

            }

        }

        <<interface>> ICommand

        <<abstract>> Bodied

        ProgramMetrics <.. ICommand : creates

        RepeatUntil --> ICondition

        If --> ICondition

        Body <-- Bodied : 1 body

        Body.Builder ..> Body : creates

        Body.Builder --> ICommand : \* commands

        Body.Builder ..> Repeat : creates

        Body.Builder ..> Turn : creates

        Body.Builder ..> Move : creates

        Body.Builder ..> RepeatUntil : creates

        Body.Builder ..> If : creates

        Body ..|> ICommand

        Body --> ICommand : \* commands

        ICommand <|.. Turn

        ICommand <|.. Move

        Repeat ..|> Bodied

        RepeatUntil ..|> Bodied

        If ..|> Bodied

        Bodied ..|> ICommand

    %%

    ICommand ..> ActualWorld : affects

    class InnerProgram{

        +WorldState Execute()

        +ProgramMetrics GetMetrics()

    }

    InnerProgram --> Body : 1 commands

    InnerProgram --> ActualWorld : 1 startWorld

    %%ProgramMetrics <.. InnerProgram

    %%region World

        namespace namespace\_World{

            class ActualWorld{

                +ActualWorld CopyState()

                +void TurnLeft()

                +void TurnRight()

                +void MoveForward(int dist)

            }

            class WorldSettings{

                %% Data that can't change while the Innerprogram is running

                -WorldCell[,] worldGrid

                +WorldCell GetCell(int2 pos)

            }

            class BlockException

            class LeftGridException

            class WorldCell{

                Empty

                Blocked

            }

            class WorldState{

                %% Data that can be changed by the program

                +WorldState Copy()

                +void TurnLeft()

                +void TurnRight()

                +void MoveForward(int dist)

                +void AddToTrace(IEventTrace event)

            }

            class PlayerState{

                +int2 pos

                +Dir4 dir

                +PlayerState Copy()

                +void TurnLeft()

                +void TurnRight()

                +void MoveForward(int dist)

            }

            class IEventTrace{

                +string TextualTrace()

            }

            class TurnTrace{

                -Dir2 dir

            }

            class MoveTrace{

                -int stepCount

            }

        }

        <<interface>> IEventTrace

        <<enumeration>> WorldCell

        ActualWorld ..> BlockException

        ActualWorld ..> LeftGridException

        ActualWorld \*-- WorldSettings

        WorldSettings --> WorldCell

        ActualWorld --> WorldState : 1 state

        WorldState \*-- PlayerState : 1 player

        WorldState \*-- IEventTrace : \* trace

        WorldState ..> IEventTrace : creates

        IEventTrace <|.. TurnTrace

        IEventTrace <|.. MoveTrace

    %%

    InnerProgram ..> WorldState : creates

    %%region Geometry2D

        namespace namespace\_Geometry2D{

            class Dir4{

                +Dir4 North $

                +Dir4 East $

                +Dir4 South $

                +Dir4 West $

                +int2 ToVector()\*

                +Dir4 Rotated(Dir2 dir)\*

                +void Rotate(ref Dir4 subj, Dir2 dir) $

                +int2 MovePoint(int2 point, int dist)

                +T Match<T>(T caseNorth, T caseEast, T caseSouth, T caseWest)

            }

        }

        PlayerState <-- Dir4

    %%

**Split into namespaces:**

Namespace Commands:

  %% namespace Commands

  classDiagram

    namespace namesapce\_Commands{

        class ProgramMetrics{

            +int commandCount

            +int maxNestingLevel

            +int repeatCommandCount

        }

        class Body.Builder{

            -Body.Builder AddCommand(ICommand command)

            +Body.Builder turn(Dir2 dir)

            +Body.Builder move(int stepCount)

            +Body.Builder repeat(int count, Body.Builder body)

            +Body.Builder body(Body.Builder addedBody)

            +Body Build()

        }

        class ICommand{

            +void ApplyOnWorld(ref ActualWorld world)

            +ProgramMetrics GetMetrics()

        }

        class ICommandAlg["ICommand.IAlgebra < Result, Cond >"]{

            +Result turn(Dir2 dir)

            +Result move(int stepCount)

            +Result repeat(int count, Result foldedBody)

            +Result body(Result[] foldedCommands)

            +Result repeatUntil(Cond foldedCondition, Result foldedBody)?

            +Cond facingBlock()

            +Cond facingGridEdge()

            +Cond not(Cond foldedInput)

        }

        class Body

        class Bodied

        class Repeat{

            -int count

        }

        class RepeatUntil

        class If

        class Turn{

            -Dir2 dir

        }

        class Move{

            -int stepCount

        }

    }

    <<interface>> ICommand

    <<interface>> ICommandAlg

    <<abstract>> Bodied

    ProgramMetrics <.. ICommand : creates

    Body <-- Bodied : 1 body

    Body.Builder ..> Body : creates

    Body.Builder --> ICommand : \* commands

    Body.Builder ..> Repeat : creates

    Body.Builder ..> Turn : creates

    Body.Builder ..> Move : creates

    Body.Builder ..> RepeatUntil : creates

    Body.Builder ..> If : creates

    Body ..|> ICommand

    Body --> ICommand : \* commands

    ICommand <|.. Turn

    ICommand <|.. Move

    ICommand ..> ICommandAlg : uses

    Repeat ..|> Bodied

    RepeatUntil ..|> Bodied

    If ..|> Bodied

    Bodied ..|> ICommand

    namespace namesapce\_Commands.Condition{

        class ICondition{

            +bool Check(ActualWorld world)

            +Result Fold < Result > (ICondition.Algebra < Result > algebra)

        }

        class IConditionAlg["ICondition.Algebra < Result >"]{

            +Result foldFacingBlock;

            +Result foldFacingGridEdge;

            +Func < Result, Result > foldNot;

        }

        class FacingBlock

        class FacingGridEdge

        class Not

    }

    RepeatUntil --> ICondition

    If --> ICondition

    ICondition ..> IConditionAlg : uses

    ICondition <|.. FacingBlock

    ICondition <|.. FacingGridEdge

    ICondition <|.. Not

Namespace World:

  classDiagram

    namespace namespace\_World{

        class ActualWorld{

            +ActualWorld CopyState()

            -WorldCell? TryGetFacedCell()

            +void TurnLeft()

            +void TurnRight()

            +void MoveForward(int dist)

            +bool FacingBlock()

            +bool FacingGridEdge()

        }

        class WorldSettings{

            %% Data that can't change while the Innerprogram is running

            -WorldCell[,] worldGrid

            +bool IsInside(int2 point)

            +WorldCell GetCell(int2 pos)

        }

        class BlockException

        class LeftGridException

        class WorldCell{

            Empty

            Blocked

        }

        class WorldState{

            %% Data that can be changed by the program

            -Queue< int2> posTrace

            +WorldState Copy()

            +void TurnLeft()

            +void TurnRight()

            +void MoveForward(int dist)

            -void AddToTrace(IEventTrace event)

        }

        class PlayerState{

            +int2 pos

            +Dir4 dir

            +PlayerState Copy()

            +void TurnLeft()

            +void TurnRight()

            +void MoveForward(int dist)

            +int2 GetFacedPoint()

        }

        class IEventTrace{

            +string TextualTrace()

        }

        class TurnTrace{

            -Dir2 dir

        }

        class MoveTrace{

            -int stepCount

        }

    }

    <<interface>> IEventTrace

    <<enumeration>> WorldCell

    ActualWorld ..> BlockException

    ActualWorld ..> LeftGridException

    ActualWorld \*-- WorldSettings

    WorldSettings --> WorldCell

    ActualWorld --> WorldState : 1 state

    WorldState \*-- PlayerState : 1 player

    WorldState \*-- IEventTrace : \* trace

    WorldState ..> IEventTrace : creates

    IEventTrace <|.. TurnTrace

    IEventTrace <|.. MoveTrace

Namespace Geometry2D:

classDiagram

    namespace namespace\_Geometry2D{

        class Dir4{

            +Dir4 North $

            +Dir4 East $

            +Dir4 South $

            +Dir4 West $

            +int2 ToVector()\*

            +Dir4 Rotated(Dir2 dir)\*

            +void Rotate(ref Dir4 subj, Dir2 dir) $

            +int2 MovePoint(int2 point, int dist)

            +T Match<T>(T caseNorth, T caseEast, T caseSouth, T caseWest)

        }

    }

Namespace GenericUI:

  classDiagram

    namespace namesapce\_GenericUI{

        class UI1{

            %% We'll probably have to split this class up for higher cohesion.

            -void SelectHardcodedProgram(InnerProgram program)

            +void SelectProgramBasic()

            +void SelectProgramAdvanced()

            +void SelectProgramExpert()

            -bool TryParseTextBoxProgram(out InnerProgram programFromBox)

            +void ClickRun()

            +void ClickMetrics()

            +void SelectExercise(string fileContent)

            +void UnselectExercise()

        }

        class UI1.IDataBridge{

            +void SetTextBoxProgram(string text)

            +void SetTextBoxOutput(string text)

            +string ReadTextBoxProgram()

            +void BlockCell(int2 p);

            +void AddGridTraceHorizontal(int y, int x0, int x1);

            +void AddGridTraceVertical(int x, int y0, int y1);

            +void SetCharacterPos(int2 p);

            +void SetDestination(int2 p);

            +void ClearExerciseStuff();

            +void ClearTrace();

        }

        class IOutputLanguage{

            +string Execute(InnerProgram program)

            +string ShowMetrics(InnerProgram program)

        }

        class OutputLanguage1

        class IParser["IParser< T>"]{

            +T Parse(string text)

            +string Unparse(T input)

        }

        class ProgramParser{

            -Body.Builder ParseCommandBody(string[] lines)

            -string[] TrimFront(string[] lines, int tabSize)

        }

        class ProgramParser.BodyUnparser

    }

    UI1 --> UI1.IDataBridge : 1 dataBridge

    UI1 --> IOutputLanguage : 1 outputLanguage

    UI1 --> ProgramParser : 1 programParser

    IOutputLanguage <|.. OutputLanguage1

    IParser <|.. ProgramParser

    ProgramParser ..> ProgramParser.BodyUnparser : uses

Namespace Applic:

  classDiagram

    namespace namespace\_Applic{

        class Application{

            +void Run()

            #InnerProgram AskForProgram()

            #void UseProgram(InnerProgram program)

        }

        class ProgramImporter{

            -string codeFolderPath

            -string importFromtxt(string fileName)

            -bool TryFindPath(string fileName, out StreamReader output)

            +InnerProgram ImportProgram(string fileName)

        }

        class ExamplePrograms{

            +InnerProgram basic1

            +InnerProgram basic2

            +InnerProgram advanced1

            +InnerProgram advanced2

            +InnerProgram expert1

            +InnerProgram expert2

            ...

        }

    }

    Application \*-- ProgramImporter : 1 programImporter

    Application \*-- ExamplePrograms : 1 examplePrograms

Namespace MSO\_P3\_Forms:

classDiagram

    namespace namespace\_MSO\_P3\_Forms{

        class Form1{

            ...

        }

        class Form1.DataBridge

        class ControlSubset{

            #Control.ControlCollection fullControlCollection

            -IConnection< Control> items

            +void AddItem(Control item)

            +void RemoveItem(Control item)

            +void Clear()

        }

        class GridBase2D{

            +int2 posTopLeft, cellSize, cellCount;

            +int2 TransfWindowToCell(int2 windowPoint, out int2 relativeWindowPoint)

            ...

        }

    }

    <<partial>> Form1

    Form1.DataBridge \*-- Form1

    Form1 \*-- GridBase2D : 1 worldGridBase

    Form1 \*-- ControlSubset : 1 exerciseGridItems

    Form1 \*-- ControlSubset : 1 playerTraceItems

Dependencies between namespaces:

  classDiagram

    namespace namespace\_MSO\_P3\_Forms{

        class Form1

        class Form1.DataBridge

    }

    namespace namesapce\_GenericUI{

        class IDataBridge

        class ProgramParser.BodyUnparser1

        class ProgramParser

        class UI1

        class IOutputLanguage

    }

    namespace namespace\_Applic{

        class ExamplePrograms

        class ProgramImporter

        class Application

    }

    class InnerProgram{

        +WorldState Execute()

        +ProgramMetrics GetMetrics()

        +T FoldCommands< T,C>(ICommand.IAlgebra<T,C> algebra)

    }

    namespace namesapce\_Commands{

        class ICommand

        class ICommand.IAlgebra

        class Body.Builder

        class ICondition

        class Body

        class ProgramMetrics

    }

    namespace namespace\_World{

        class ActualWorld

        class PlayerState

        class WorldState

    }

    namespace namespace\_Geometry2D{

        class Dir4

    }

    %%from MSO\_P3\_Forms

    Form1 \*-- UI1

    Form1.DataBridge ..|> IDataBridge

    %%from GenericUI

    IOutputLanguage ..> InnerProgram : uses

    IOutputLanguage ..> WorldState : uses

    UI1 \*-- ExamplePrograms : 1 examplePrograms

    UI1 ..> InnerProgram : ClickRun uses

    UI1 ..> WorldState : ClickRun uses

    ProgramParser ..> Body.Builder : creates

    ProgramParser.BodyUnparser1 ..|> ICommand.IAlgebra

    %%from Applic

    Application ..> ProgramMetrics : uses

    IOutputLanguage <-- Application : 1 outputLanguage

    ProgramParser <.. ProgramImporter : uses

    ProgramImporter ..> InnerProgram : creates

    ExamplePrograms ..> Body.Builder : creates

    ExamplePrograms --> InnerProgram

    %%from Commands

    ICommand ..> ActualWorld : affects

    %%from InnerProgram

    InnerProgram --> Body : 1 commands

    InnerProgram --> ActualWorld : 1 startWorld

    InnerProgram ..> WorldState : creates

    %%from Geometry2D

    PlayerState <-- Dir4

Design patterns:

* The use of UI1 and IDataBridge looks like a design pattern to me, but I don’t yet know which one. Maybe façade, template method or mediator.
* ICommand and ICondition use a fold and algebra. This is a pattern taught in the course ‘languages and compilers’. Maybe it counts as a design pattern here.

Deviations from practical 2 design:

* See ‘Refactoring examples’ in part 2 for some of these deviations.
* Extracted abstract class ‘Bodied’ from the repeat-command, because there are now multiple command types that use a body in a similar way.
* …

# **Part 2 Implementation and code quality**

Measures taken:

* …

Refactoring examples:

* Use of class Bodied. …
* Use of IOutputLanguage. …
* Extracted the ProgramParser-class for ProgramImporter and split its parse-function into multiple parse-functions, one for each command-type, for higher cohesion.
* Created IOutputLanguage, so the programmer has more freedom in where and how to display textual output. It no longer needs to be by the console, and it no longer needs to use the exact sentence structure that used to be hard-coded in the old methods.

Changes inspired by metrics:

* …

# **Part 3 Evaluation**

Likely future changes:

* …

High cohesion:

* …
* ICommand now has method Fold, so not every method that needs to distinguish between different types of ICommand-realizations needs to be inside ICommand anymore. Otherwise, ICommand could get too many different responsibilities.

Low coupling:

* Every action of every UI-element in the form is directly connected to a method of class UI1, so our model handles basically every somewhat complex responsibility. This makes it easy to replace the form with any other type of UI, as long as that other UI has similar elements.
* …

# **Part 4 Testing**

Test fails + reasons:

* …

# **Part 5 Work distribution & retrospective**

Task distribution:

Part 1: …

Part 2: …

Part 3: ...

Part 4: …

What went well:

…

What could have been better:

…

What we learned:

…