Introduction

• What is the programming language and what it stands for
• What benefits provide usage of programming languages for CAPI
• C# language to power calculation of conditions and validations
Objects

- Questionnaire in Survey Solutions consist of objects
  - Rosters
  - Questions
  - User defined variables, lookups, macros...
- Each object has attributes and methods for administration
  - Variable name
  - Question text/Section title, question specific properties
- Answers on question has different type from question type
Object types

• Simple types:
  ▫ String
    • “some text”
  ▫ Int
  ▫ Double
    • 3.14159
  ▫ Boolean
    • True/false

• Complex types:
  ▫ DateTime
  ▫ Geo location
  ▫ Audio
  ▫ Yes/No answer
  ▫ Text list question

• Arrays
  ▫ [1, 2, 3, 4]

• Array can be accessed by index
• Index start from zero
  ▫ Household[1]
  ▫ Household[2]
Complex types and rosters

- Complex types like DateTime and GPS answer consist of other objects
- To access properties of complex type answer C# syntax use `dot`

- So if we have GPS question `Gps`
  - Then we access it’s properties via `dot`
    - `Gps.Latitude`
    - `Gps.Longitude`
    - `Gps.Accuracy`

- Roster items are also complex types
- Use `dot` to access roster item variables
  - `Household[0].age`
  - `Household[0].sex`
Operators

• Relational
  ▫ Equal to:  
  ▫ Greater, less than:
    > , >= , =< , <
  ▫ Not equal to: !=

• Logical
  ▫ And: &&
  ▫ Or: ||
  ▫ Contrary: !
  ▫ If-then: exp1 ? exp2 : exp3

• Mathematical
  ▫ Addition:  
  ▫ Subtraction:  
  ▫ Division:  
  ▫ Multiplication:  
  ▫ Many other operators: C# Math library

• Object instantiation:
  ▫ new DateTime(2018, 05, 30)
Nullability

- Answer on question that is not answered will be **NULL**
- Integer, double and DateTime type cannot be null
- In Survey Solutions answers of those types wrapped in nullable form
- Accessing for value is happen through `.Value` notation
- “Shorthand” is `?.` notation

```csharp
Enabling condition (?) □ Hide if disabled (?)

date?.Year == 2017
```
Functions

- Function is something that take an input and produce an output
- Function intakes one or more arguments and returns single result

$$function(x) \begin{cases} x + 1 \end{cases}$$

- $function(2) \Rightarrow 3$
- $function(0) \Rightarrow 1$
Functions

- Functions can have several arguments
- In C# notation function syntax consists of function name, function return type, list of arguments with specified type and a function body

```csharp
int Max(int a, int b)
{
    return a > b ? a : b;
}
```
Type conversion

- In C# one type can be converted into another
- What You need is parenthesis and proper type name
  - `(decimal?) DayOfVisit?.Year`
- Why You needed:
  - Nowadays it’s quite rare operation
  - Most of the type conversions happen automatically
  - But sometimes we need explicit type conversion

// date of interview must come after, and thus be greater than, DOB
date_q1 > (new DateTime((int) date_q2_year, (int) date_q2_month, (int) date_q2_day ))
Comments

• It’s helpful to comment what do particular number code means
• Two types of comments:
  ▫ // - will comment whole line. Text after // will be ignored
  ▫ /* some text */ inline block of comments

```csharp
// either "none" is selected and no other option...
self.ContainsOnly(1)

||

// ...or there is one or more option selected but it's not "none"
(self.Length>=1 && !self.Contains(1 /* none */)) ```
Text functions

- Answer on text question has type **String**
- Properties
  - `Q.Length`
- Functions:
  - `Q.Contains(string value)`
  - `Q.ConsistsOf(string chars)`
  - `Q.IsAlphaLatin()`
  - `Q.StartsWith/EndsWith(string val)`
  - `Q.IsNumber()`
- There is also helper functions inside **String** object
  - `String.IsNullOrEmptyWhiteSpace(Q)`
- Barcodes are strings
Numeric functions

- Comparison to a range or values
  - `Q.InRange(a, b)`
    - Return true if \( a \leq Q \leq b \)
  - `Q.InList(a, b, c)`
    - Return true if \( Q \) equal to \( a, b \) or \( c \)
- Math object contains a lot of useful mathematic functions
  - Abs, Floor, Max, Min, Pow, etc...
  - You can refer to Survey Solutions Support portal or C# Math class description

```csharp
// check that age falls within bounds
self.InRange(0, 120)
```

```csharp
// answer must be an integer between 1 and 6
self.InList(1, 2, 3, 4, 5, 6)
```

```csharp
// check that value is a multiple of 5--the
(self % 5) == 0
```

```csharp
Invalid value. Please enter a valid currency
```

```csharp
Math.Max(self, numeric_q1) < 5
```
Categorical questions

- For single select questions, answer is numeric value
- For Multi-Select question answer is an array of selected codes
- Common functions are:
  - Q.Contains(value)
  - Q.ContainsAll(v1, v2, …)
  - Q.ContainsOnly(v1, v2, …)
  - Q.ContainsAny(v1, v2, …)

- Categorical Yes/No question
- Answer on this question is complex type
- It consist of four main parts
  - Q.Yes. Contains the values with “yes” answer
  - Q.No. Contains the values with “no” answer
  - Q.Missing. Contains values without answer
  - Q.All. Contains all values answered or not

- All those properties are arrays of codes
- You can use any common functions for single select question
Yes no sample

Question text

FOR A PARTICULAR ITEM
Does your household own any ...?

| 501  | Mortar/pestle (mtonco) |
| 502  | Bed                   |
| 503  | Table                 |
| 504  | Chair                 |
| 505  | Fan                   |

Validation condition 1 (?) □ Is warning

/* however poor, owns a bed */

// are all items answered (aka does the array Missing have any item values)?
  self.Missing.Any() ?

// if yes, return true--that is no validation error--for now
true:

// if no, determine whether item 502 (bed) has a "yes" answer
self.Yes.Contains(502)

Error or warning message (?)

Unlikely answer. Most households have a bed
DateTime

- **Methods**
  - `FullYearsSince(DateTime? Date)`
  - `InRange(DateTime? dateA, DateTime? dateB)`
- **Properties**
  - `Q?.Year`, `Q?.Month`, `Q?.Day`
  - `Q?.Hour`, `Q?.Minute`, `Q?.Second`
  - `Q?.DayOfYear`
GPS Location

- Properties:
  - Latitude, Longitude, Accuracy and Altitude

- Functions:
  - Q.InRectangle(north, west, south, east)
  - Q.GpsDistance(gps) distance from Q to gps in meters
  - Q.GpsDistanceKm(gps) distance from Q to gps in kilometers

```python
# Validation condition 1
gps_q1.GpsDistance(gps_q2)<10

// the second coordinates must be at least 10 meters away from the first coordinates
```

```python
# Validation condition 2
self.Accuracy<=5

// only accept GPS measures with accuracy of plus or minus 5 meter
```
Text list

• Answer on text list questions is an array of complex type with properties
  ▫ Item1 – is a number
  ▫ Item2 – is a value of text list item
• For example, household_members = [
  ▪ 1, “Mary”),
  ▪ 2, “Paul”}
  ▪ ]

• Useful properties are Q.Length for number of items
• For particular item – Q.Item2
Lambda and LINQ

- **Useful functions**
  - `Q.Count(x => x)`
  - `Q.Where(x => x)`
  - `Q.Select(x => x)`
  - ...

- **For example**
  - `Members.Count(person => person.sex == 1)`
  - `Members.Where(person => person.age > 15).Min()`
  - `Foods.Select(item => item.weight * item.calories).Sum()`
Exercise

1. In dwelling section ask the household owner - do they own a car, a garage, a microwave, a fridge or a washer
2. Ask the owner of the household to answer where they park a car for the night if there is no garage in the answer
3. Ask where household members wash their clothes if there is no washer