SWEN90016
Software Processes & Project Management

Function points (in depth example)

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Lecture 7

Function Points (FP)

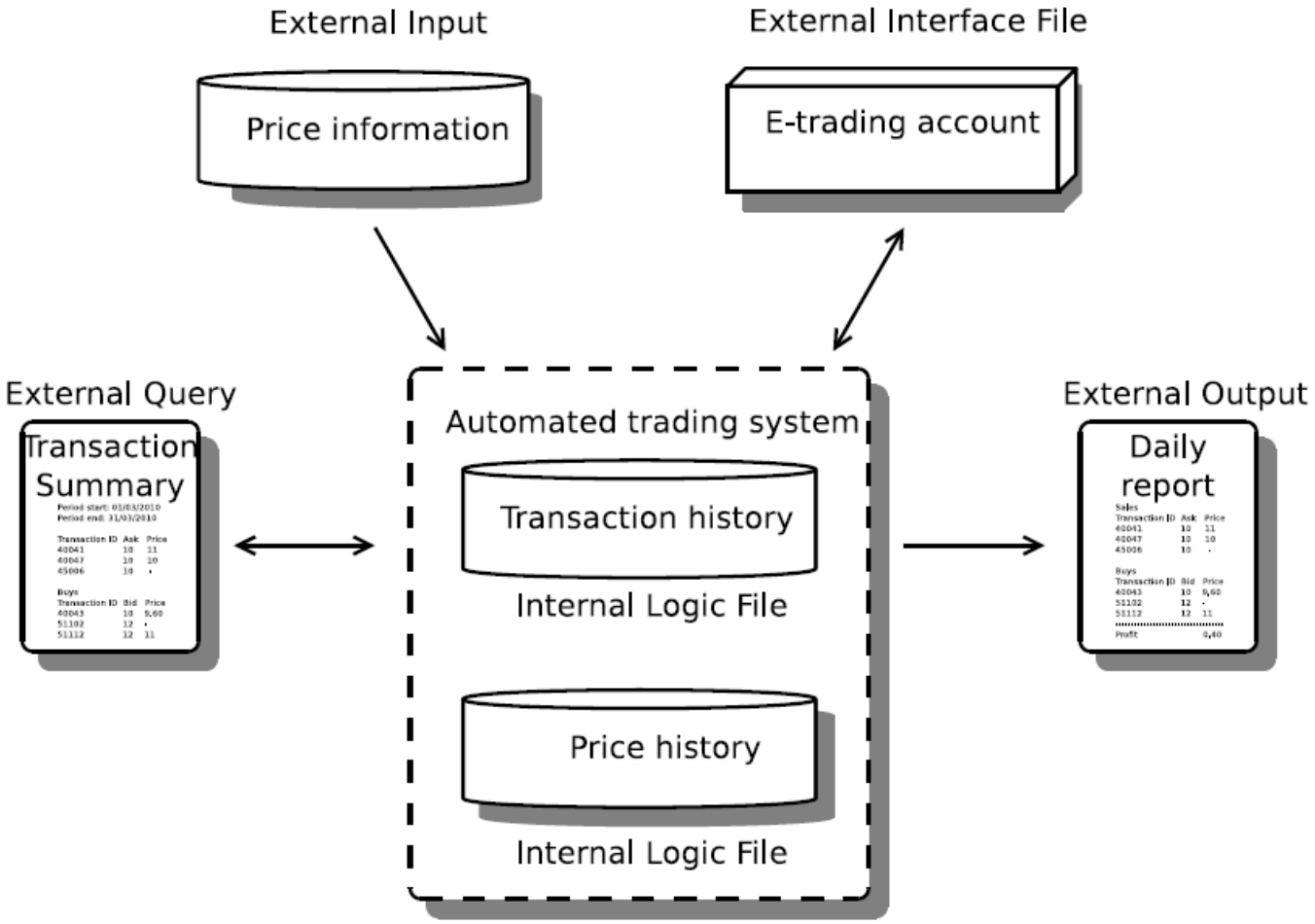
- Is used to express the *amount of functionality* in a software system, as seen by the user
- A *higher number of function points* indicates *more functionality*
  - Empirical evidence demonstrates that there is a *positive correlation between function points and the complexity* of the system
- Typically used to:
  - Estimate the cost and effort required to design, code and test a software system
  - Predict the number of errors
  - Predict the number of components
  - Measure productivity
- Function points are computed from the *Software Requirements Specification (SRS)*

Software Requirements

- **Software Requirements Specification (SRS)**
  - A document that specifies what is expected of a software system; referred to as the requirements of the system
  - It contains:
    - Functional Requirements:
      - Specify the functions that are required in the system
    - Non-functional Requirements:
      - Specify requirements that are not directly functions, such as performance, reliability, scalability etc. (quality requirements)

Example: Functional Requirements

Automated Trading System



Example: Automated Trading System

Automated Trading System: Functional Requirements

R.1	Read the previous day's trading information (high price, low price, opening price, closing price) from a third-party-server.
R.2	Save a complete "price history" in a database.
R.3	Based on the trends in prices for commodities, decide which commodities to bid for, and which to try to sell.
R.4	Send information to an external e-trading account which places the bid/ask for each commodity.
R.5	When the bid/ask is either accepted or expires, record the result in a "transaction history" database.
R.6	At the end of the day, produce a report that summaries the transactions of the day along with the following information: profit/loss for the day; number of trades of each commodity; average market price of all commodities; account summary.
R.7	At anytime the user can request a transaction history for a period which gives: transaction IDs; commodity type; bid/ask; price.

FP Computation Steps

1. Categorize requirements
2. Estimate a *complexity value* for each category or function
3. Compute *count total* from Complexity
4. Estimate *value adjustment factors*
5. Compute *total function point count*

FP Computation Steps

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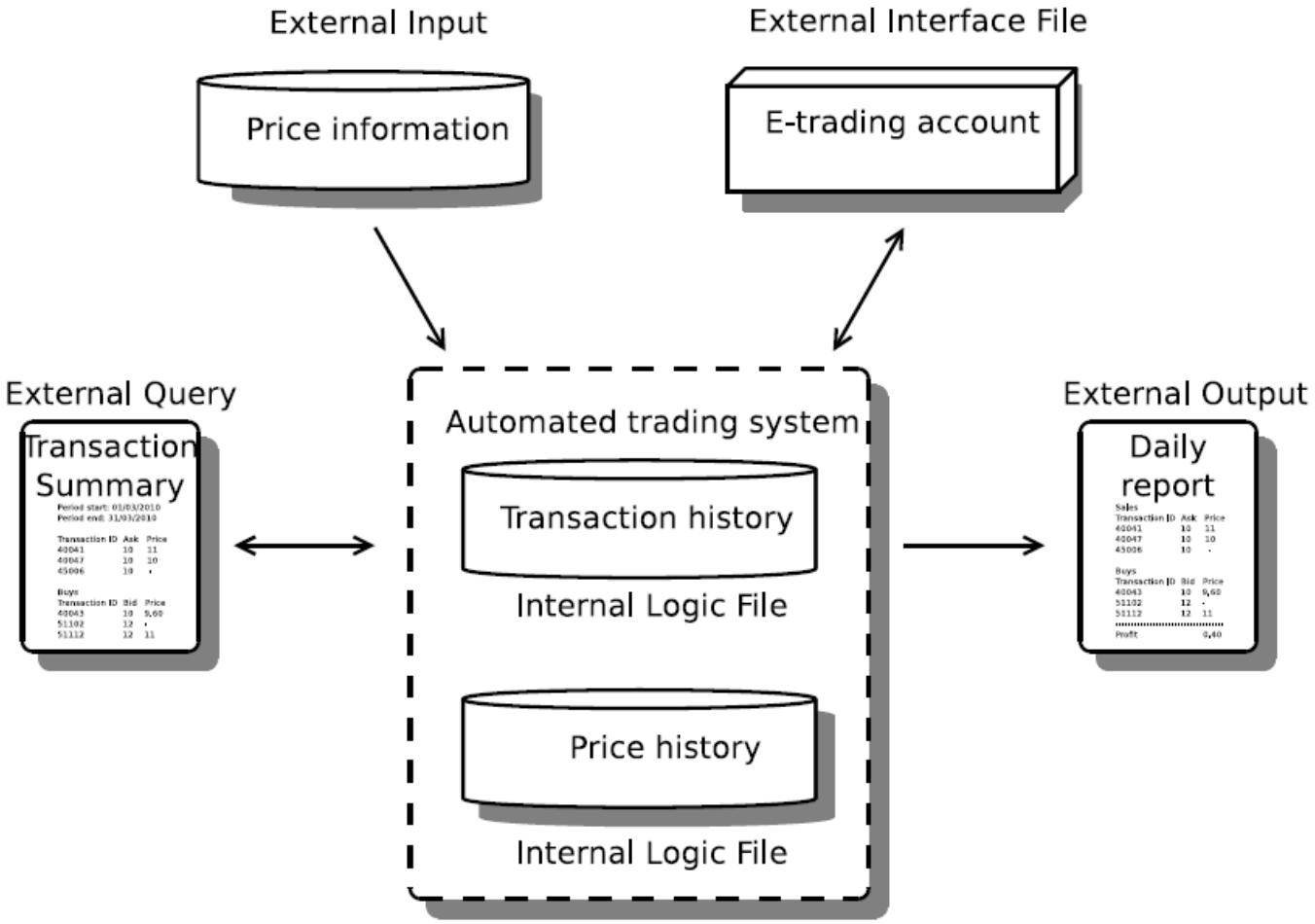
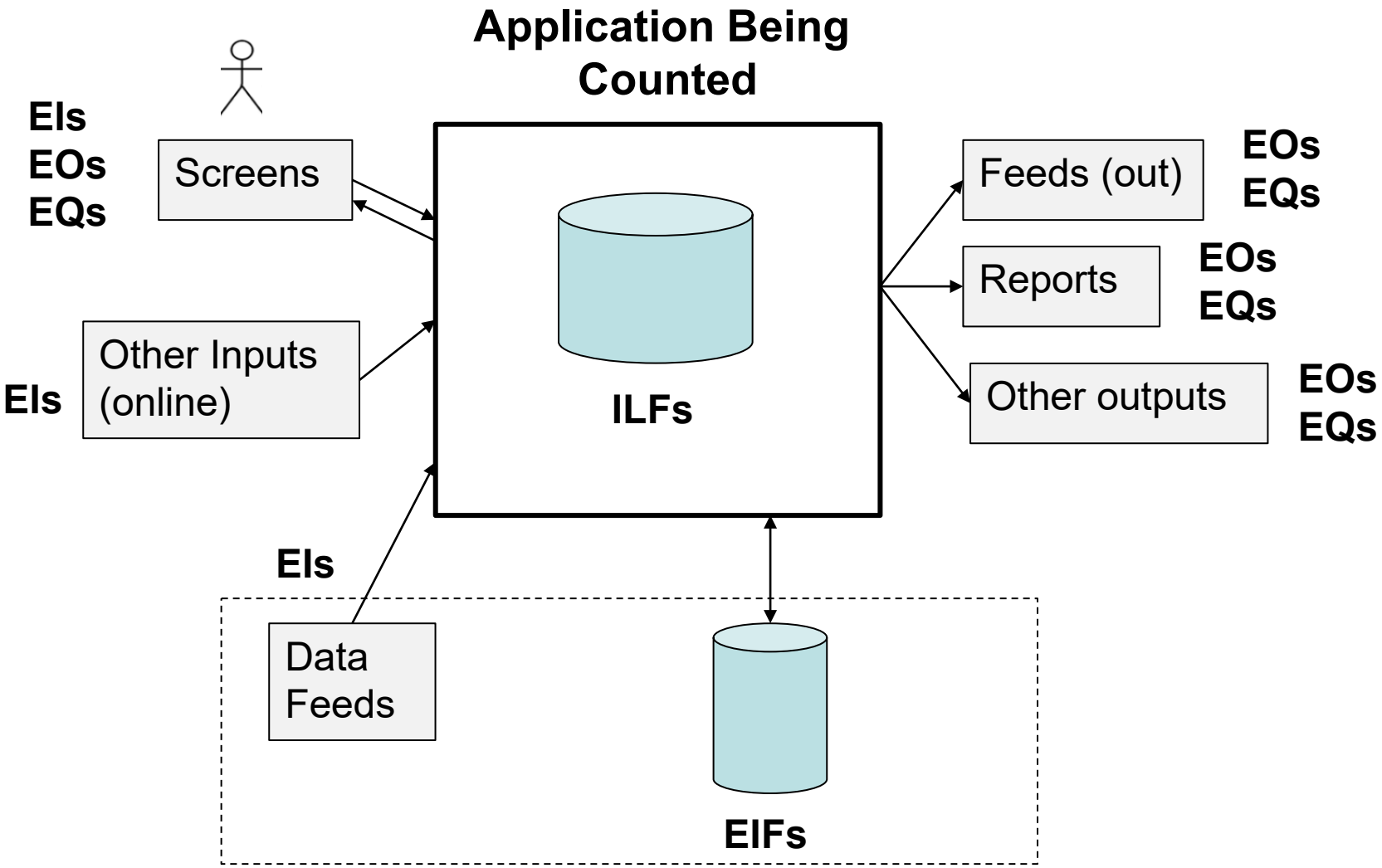
Example: Functional Requirements

Automated Trading System

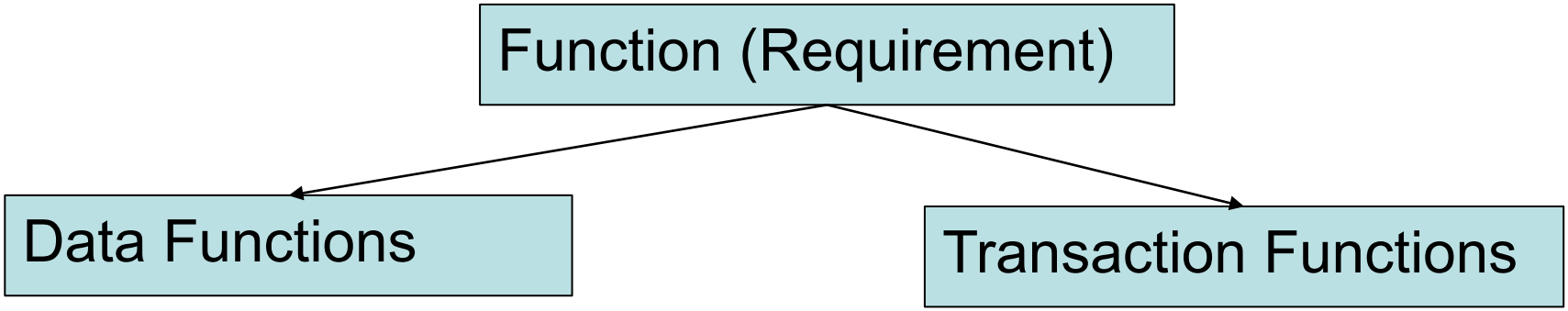


FP Computation – Step 1



FP Computation – Step 1

1. Categorize Requirements



Data Functions:

- Concerned with maintenance of the data for the application – Internal Logical Files (ILF), External Interface Files (EIF)

Transaction Functions:

- Concerned with information being passes to and from the system - External Inputs (EI), External Output (EO), External Inquiries/Queries (EQ)

FP Computation – Step 1

1. Categorize Requirements (five categories)

Data Functions

- **Internal Logical File (ILF)**
  - A logical grouping of data that the system maintains over a period of time, and is modified using external inputs

    examples - tables in a relational database, files containing user setting

- **External Interface File (EIF)**
  - A logical grouping of data that is maintained external to the system, but which may be used by the system.

    examples - are the same as ILFs, except that the data is maintained outside the system, such as data hosted on a third-party servers, or data structures holding information about system state

FP Computation - Step 1

Transaction Functions

- **External Input (EI)**
  - An input to the system from a user or another application, which is used to control the flow of the system, or provide data. External inputs generally modify internal logic files

    examples - data fields populated by users, inputs files (e.g. program source code to a compiler), and file feeds from an external application.

- **External outputs (EO)**
  - An output to the user that provides information about the state of the system

    examples - screens, error messages, and reports that are shown to the user. Individual data fields in these are grouped as one external output

FP Computation – Step 1

– **External Inquiries/Queries (EQ)**

- the input is not used to update an internal logic file, but is used to query the internal logic file and provide an output; the output is retrieved directly, with no derived data included

  examples - reading a user setting, or reading a record from a database table

Example: Automated Trading System

Automated Trading System: Function Categories

R.1	Read the previous day's trading information (high price, low price, opening price, closing price) from a third-party-server.	EI
R.2	Save a complete "price history" in a database.	ILF
R.3	Based on the trends in prices for commodities, decide which commodities to bid for, and which to try to sell.	
R.4	Send information to an external e-trading account which places the bid/ask for each commodity.	EIF
R.5	When the bid/ask is either accepted or expires, record the result in a "transaction history" database.	ILF
R.6	At the end of the day, produce a report that summaries the transactions of the day along with the following information: profit/loss for the day; number of trades of each commodity; average market price of all commodities; account summary.	EO
R.7	At anytime the user can request a transaction history for a period which gives: transaction IDs; commodity type; bid/ask; price.	EQ

FP Computation Steps

1. Categorize requirements
2. Estimate a *complexity value* for each category or function
3. Compute *count total* from Complexity
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5. Compute *total function point count*

FP Computation – Step 2

2. Estimate a *complexity value* for each category or function

- Complexity is ranked either ***simple, average or complex***
- Normally ***assigned for a category*** rather than for each requirement – rather crude
- A technique commonly used is based on Data Element Types (DETs), Record Element Types (RETs), and File Type References (FTRs):

Data Element Types (DETs)	A unique, user-recognizable, non-repeated data field in a system
Record Element Types (RETs)	A user-recognizable subgroup of data elements in an ILF or EIF
File Type References (FTRs)	A file (ILF, EIF) referenced by a transaction

FP Computation – Step 2

Relationship between DETs, RETs, FTRs, and the function categories

Function	DETs	RETs	FTRs
Internal Logical Files (ILFs)	x	x	
External Interface Files (EIFs)	x	x	
External Inputs (EIs)	x		x
External Outputs (EOs)	x		x
External Inquiries (EQs)	x		x

Complexity table for Data Functions

	DETs		
RETs	1-19	20-50	51+
1	Simple	Simple	Average
2-5	Simple	Average	Complex
6+	Average	Complex	Complex

Complexity table for Transaction Functions

	DETs		
FTRs	1-5	6-19	20+
1	Simple	Simple	Average
2-3	Simple	Average	Complex
4+	Average	Complex	Complex

Example: Automated Trading System

Automated Trading System: Function Categories

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R.7	At anytime the user can request a transaction history for a period which gives: transaction IDs; commodity type; bid/ask; price.	EQ

Example: Automated Trading System

Automated Trading System: Function Categories

			DETs	RETs	FTRs	Complexity
R.1	**EI**	high price, low price, opening price, closing price, date	5		1	Simple
R.2	**ILF**	commodity name, high price, low price, opening price, closing price, date	6	1		Simple
R.3						
R.4	**EIF**	Commodity, bid/asking price, buy/sell	3	1		Simple
R.5	**ILF**	…	4	1		Simple
R.6	**EO**	…	5		3	Simple
R.7	**EQ**	…	4		2	Simple

FP Computation Steps

1. Categorize requirements
2. Estimate a *complexity value* for each category or function
3. Compute *count total* from Complexity
4. Estimate *value adjustment factors*
5. Compute *total function point count*

FP Computation – Step 3

3. Compute *count total* from Complexity

- Using count and complexity estimates compute total count

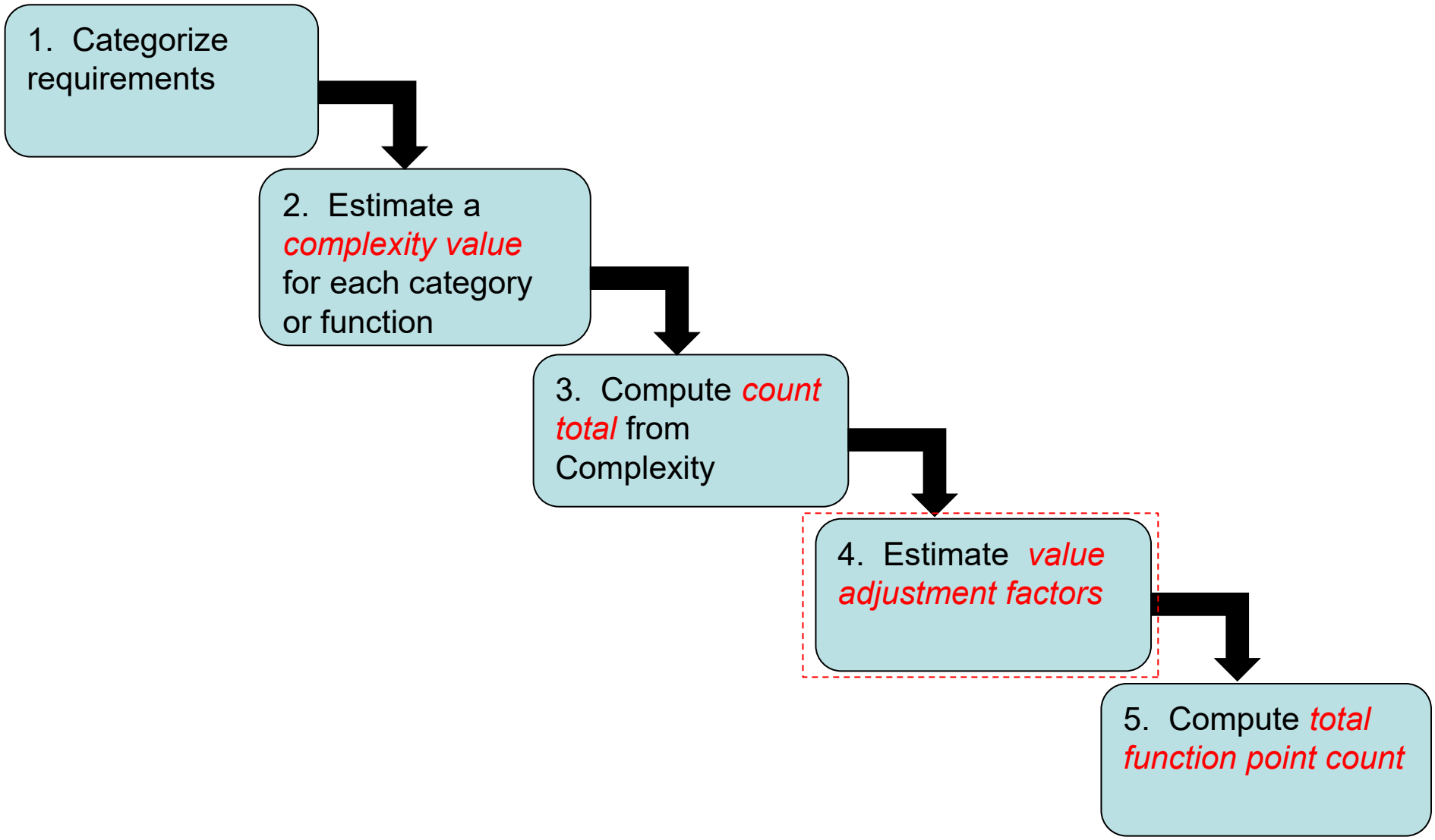
Information Domain Value	Count		Weighting Factor Simple	Average	Complex		
Internal Logical Files (ILFs)		×	7	10	15	=	
External Interface Files (EIFs)		×	5	7	10	=	
External Inputs (EIs)		×	3	4	6	=	
External Outputs (EOs)		×	4	5	7	=	
External Inquiries (EQs)		×	3	4	6	=	
Count total							

Example: Automated Trading System

Automated Trading System: Computing Count Total

Information Domain Value	Count		Weighting Factor Simple	Average	Complex		
Internal Logical Files (ILFs)	2	×	7	~~10~~	~~15~~	=	14
External Interface Files (EIFs)	1	×	5	~~7~~	~~10~~	=	5
External Inputs (EIs)	1	×	3	4	~~6~~	=	3
External Outputs (EOs)	1	×	4	~~5~~	~~7~~	=	4
External Inquiries (EQs)	1	×	3	4	~~6~~	=	3
Count total							29

FP Computation Steps



FP Computation – Step 4

4. Compute value adjustment factors

- is computed based on 14 characteristics
- each of the characteristics is ranked on a scale of 0-5; 0 not important and 5 critical

- Data Communications
- Distributed Data Processing
- Performance
- Heavily Used Configuration
- Transaction Rate
- Online Data Entry
- End-User Efficiency

- Online Update
- Complex Processing
- Reusability
- Installation Ease
- Operational Ease
- Multiple Sites
- Facilitate Change

Example: Automated Trading System

Automated Trading System: Value Adjustment Factors

- Data Communications - 2
- Distributed Data Processing - 4
- Performance - 5
- Heavily Used Configuration - 2
- Transaction Rate - 4
- Online Data Entry - 2
- End-User Efficiency - 5

- Online Update - 2
- Complex Processing - 2
- Reusability - 2
- Installation Ease - 2
- Operational Ease - 2
- Multiple Sites - 2
- Facilitate Change - 2

Assume the rating for all other features is 2

Value Adjustment = 2*5 + 4*2 + 10*2 = 38

FP Computation Steps

1. Categorize requirements
2. Estimate a *complexity value* for each category or function
3. Compute *count total* from Complexity
4. Estimate *value adjustment factors*
5. Compute *total function point count*

FP Computation – Step 5

5. Compute *total function point*

- Count total and value adjustment factors are then plugged-in to the following formula to estimate the total point count

$$FP = count\ total \times (0.65 + 0.01 \times \sum_{i=1}^{14} F_i)$$

F_i- VAF corresponding to the *i-th* VAF question

Example: Automated Trading System

Automated Trading System: Compute total function point count

$$FP = count\ total \times (0.65 + 0.01 \times \sum_{i=1}^{14} F_i)$$

FP = 29 x(0.65 + 0.01*38)
= 29 x1.03
= 29.87

More information and examples of FPs can be found at https://alvinalexander.com/FunctionPoints/FunctionPoints.shtml

Function Points

- **Advantages of Function Points**
  - Measures the size of the solution instead of the size of the problem
  - Requirements are the only thing needed for function points count
  - Can be estimated early in analysis and design
  - Is independent of technology
  - Is independent of programming languages

Function Points

- **Disadvantages of Function Points**
  - A well defined requirements specification is necessary
  - Gaining proficiency is not easy, the learning curve is quite long
  - Could be quite time-consuming thus could be costly

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