Lecture # 34

Structured Analysis and Design Technique

SADT

- We'll talk about Structured Analysis and Design Technique (SADT) and also apply it to the Banking System case study in today's lecture

Function-oriented Modeling Techniques

- Structured requirements definition
- Structured analysis and system specification
- Modern structured analysis
- **Real-time structured analysis and structured design**
- **Structured analysis and design technique**
- PSL/PSA

Structured Analysis and Design Technique (SADT)

Structured Analysis and Design Technique (SADT)

- A model of the problem is constructed, which is composed of hierarchy of diagrams
- Each diagram is composed of boxes and arrows
- The topmost diagram, called the context diagram, defines the problem most abstractly

Structured Analysis and Design Technique (SADT)

- As the problem is refined into sub-problems, this refinement is documented into other diagrams
- Boxes should be given unique names that should always be verb phrases, because they represent functions

Structured Analysis and Design Technique (SADT)

- All boxes should be numbered in the lower right corner, to reflect their relative dominance
- Arrows may enter top, left, or bottom sides of the box, and can exit only from the right side of the box

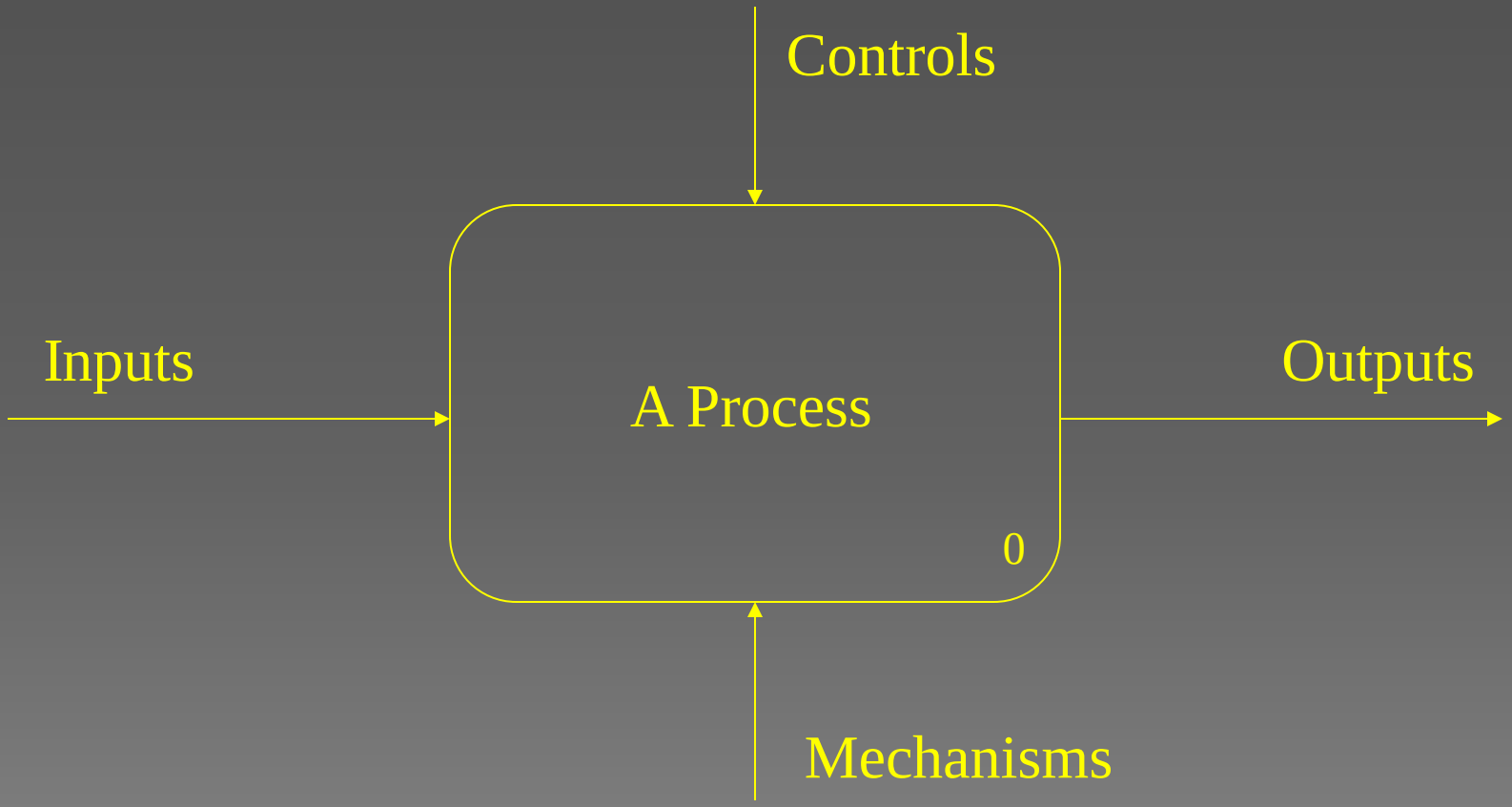
Structured Analysis and Design Technique (SADT)

- An arrow pointing into the left side of a box represents things that will be *transformed* by the box. These are inputs
- An arrow pointing down into the top of the box represents *control* that affects how the box transforms the things entering from left side

Structured Analysis and Design Technique (SADT)

- Arrows entering the bottom of a box represent *mechanism* and provide the analyst with the ability to document how the function will operate, who will perform it, or what physical resources are needed to perform the function

An SADT Context Diagram



IDEF0 Fundamentals

- Diagrams based on simple box and arrow graphics, arrows convey data or objects
- Text labels to describe boxes and arrows and glossary and text to define the precise meanings of diagram elements
- Box name shall be a verb or verb phrase, such as "Perform Inspection", arrows are nouns

IDEF0 Fundamentals

- Gradual exposition of detail, with the major functions at the top and with successive levels of sub functions revealing well-bounded detail breakout
- The limitation of detail to no more than six sub functions on each successive function
- A "node chart" that provides a quick index for locating details within the hierarchic structure of diagrams

IDEF0 – Rules

- There is always an A-0 context diagram, and its box number is always 0. This is a strict part of the standard that helps identify the overall description of the system
- A non-context diagram has from 3 to 6 boxes. This helps us manage detail

IDEF0 – Rules

- Each box is numbered in its lower right corner, generally going upper left to lower right on the diagram. This gives us a consistent way to lay out the diagram
- Arrows have horizontal and/or vertical segments, never diagonal. This makes the diagrams more readable

IDEF0 – Rules

- Each box has at least one control and output. This keeps us from using boxes with little purpose
- Successive detail diagrams are numbered by "building up" diagram and box numbers. This is one of the most important concepts, that leads to a collection of easy-to-understand diagrams rather than a single confusing one

IDEF0 – Rules

- Unconnected ends of boundary arrows are identified by their ICOM codes. This helps identify arrows when moving from one diagram to another.
- Fork and/or join arrows, rather than using parallel arrows for the same object. This reduces clutter, and reduces the likelihood that an arrow could be overlooked because it is in another part of the diagram

Banking System Case Study

Problem Description - 1

- A bank has several automated teller machines (ATMs), which are geographically distributed and connected via a wide area network to a central server. Each ATM machine has a card reader, a cash dispenser, a keyboard/display, and a receipt printer. By using the ATM machine, a customer can withdraw cash from either checking or savings account, query the balance of an account, or transfer funds from one account to another. A transaction is initiated when a customer inserts an ATM card into the card reader. Encoded on the magnetic strip on the back of the ATM card are the card number, the start date, and the expiration date. Assuming the card is recognized, the system validates the ATM card to determine that the expiration date has not passed, that the user-entered PIN (personal identification number) matches the PIN maintained by the system, and that the card is not lost or stolen. The customer is allowed three attempts to enter the correct PIN; the card is confiscated if the third attempt fails. Cards that have been reported lost or stolen are also confiscated.

Problem Description - 2

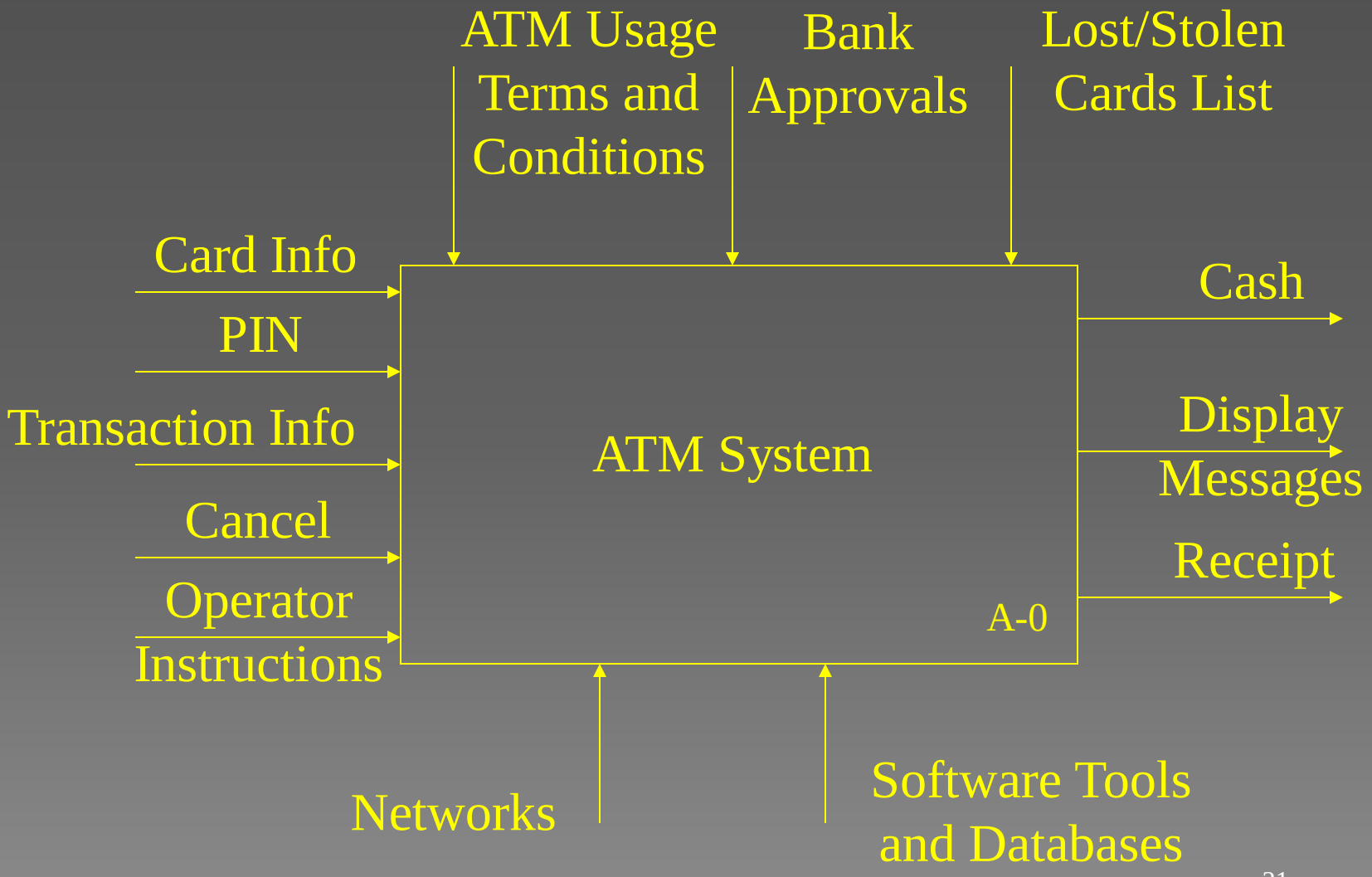
- If the PIN is validated satisfactorily, the customer is prompted for a withdrawal, query, or transfer transaction. Before withdrawal transaction can be approved, the system determines that sufficient funds exist in the requested account, that the maximum daily limit will not be exceeded, and that there are sufficient funds available at the local cash dispenser. If the transaction is approved, the requested amount of cash is dispensed, a receipt is printed containing information about the transaction, and the card is ejected. Before a transfer transaction can be approved, the system determines that the customer has at least two accounts and that there are sufficient funds in the account to be debited. For approved query and transfer requests, a receipt is printed and card ejected. A customer may cancel a transaction at any time; the transaction is terminated and the card is ejected. Customer records, account records, and debit card records are all maintained at the server.

Problem Description - 3

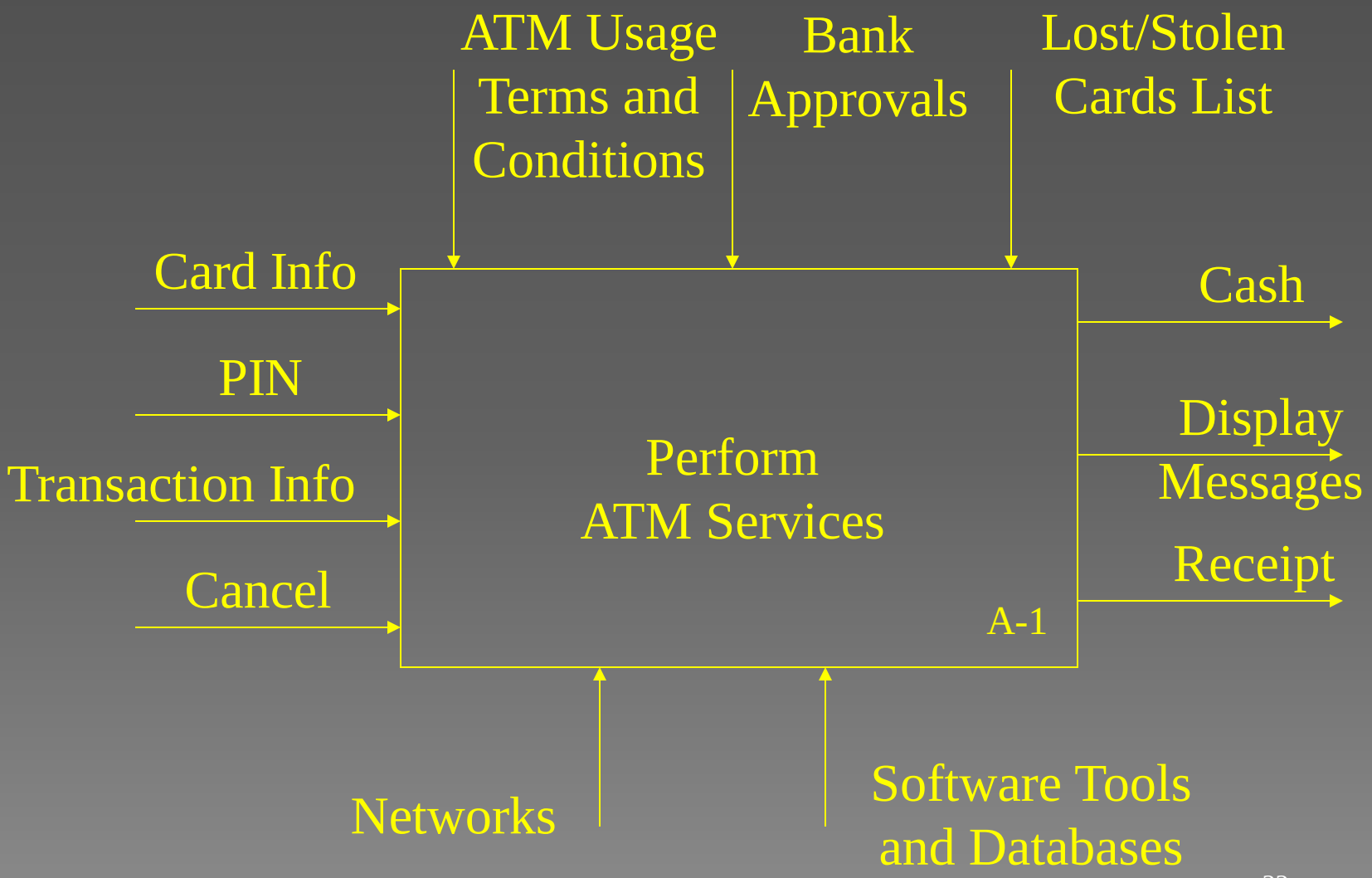
- An ATM operator may start up and close down the ATM to replenish the ATM cash dispenser and for routine maintenance. It is assumed that functionality to open and close accounts and to create, update, and delete customer and debit card records is provided by an existing system and is not part of this problem.

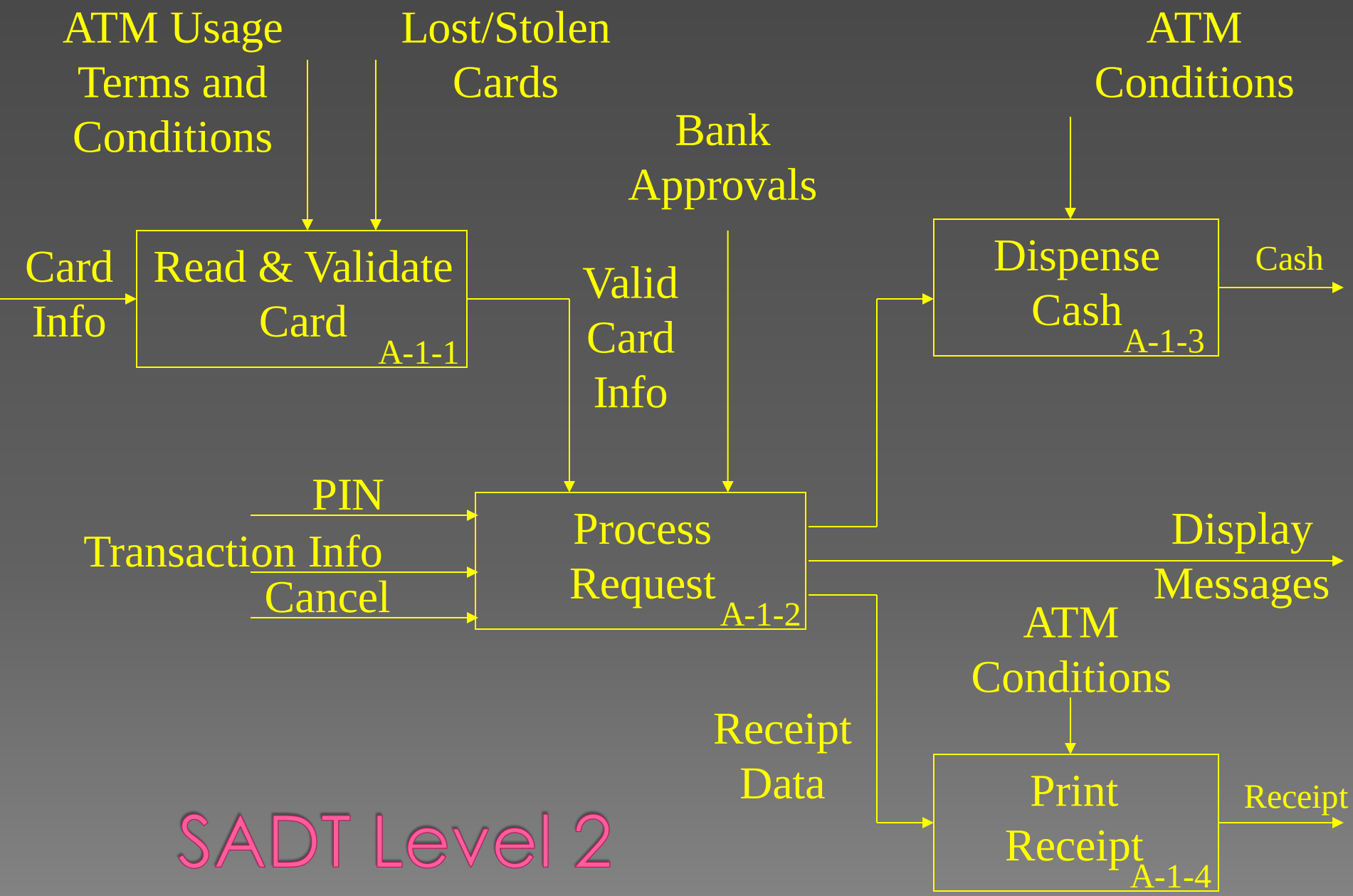
- 'Designing Concurrent, Distributed, and Real-Time Applications with UML' by H. Gomaa, Addison-Wesley, 2000

Banking System Context Diagram



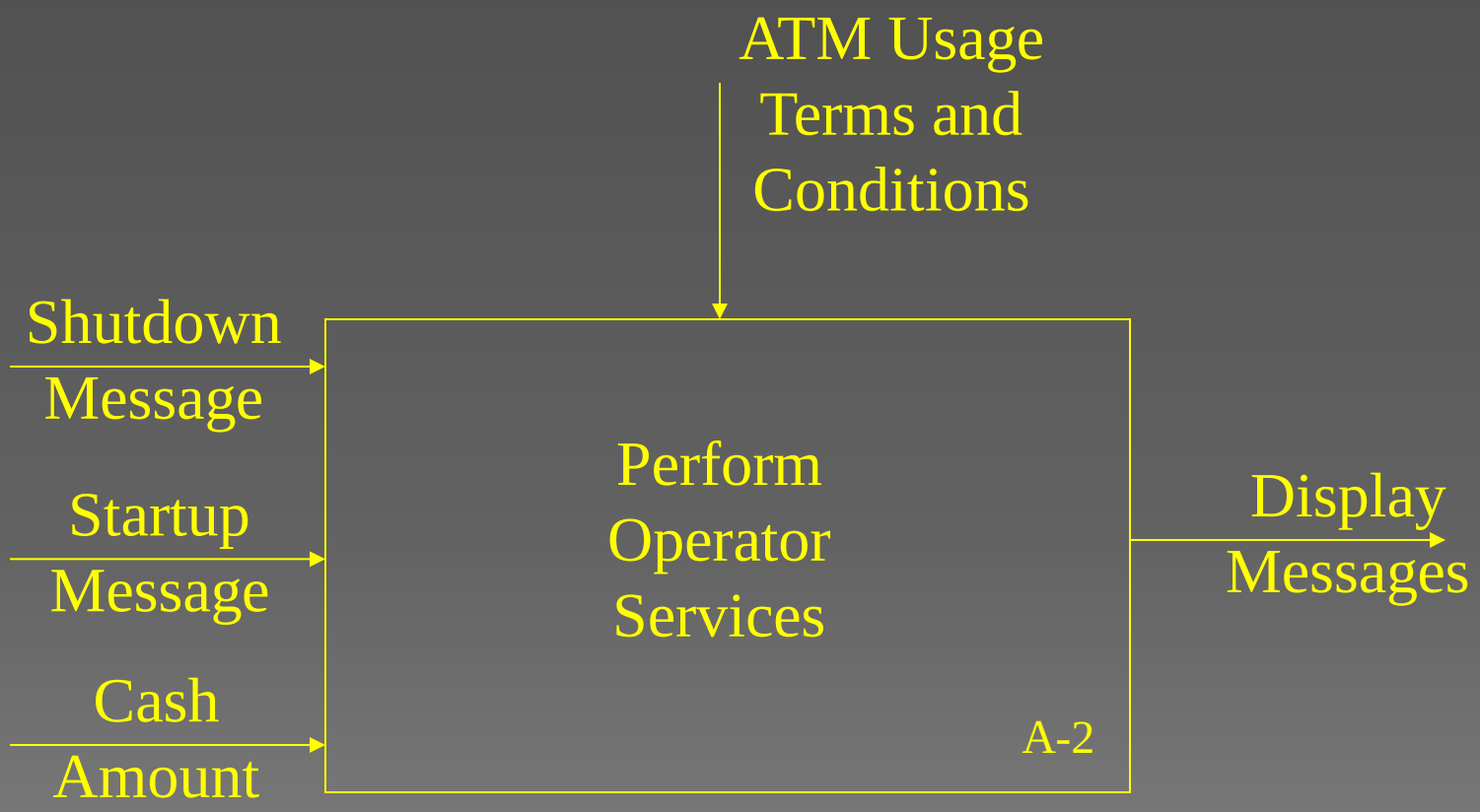
SADT Level 1 Diagram




ATM Usage Terms and Conditions
Lost/Stolen Cards
ATM Conditions
Bank Approvals
Card Info
Read & Validate Card
A-1-1
Valid Card Info
Dispense Cash
A-1-3
Cash
PIN
Transaction Info
Cancel
Process Request
A-1-2
Display Messages
ATM Conditions
Receipt Data
Print Receipt
A-1-4
Receipt

SADT Level 2

SADT Level 1 Diagram



Application of SADT

- This is an application of SADT technique on the ATM system. This can be decomposed further

Summary

- We have introduced the Structured Analysis and Design Technique
- We have introduced the IDEF modeling
- We have applied the IDEF modeling of SADT on the Banking System Case Study

References

- ‘Software Requirements: Objects, Functions, and States’ by Al. Davis, 1993