

R E P O R T R E S U M E S

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RESOURCE ALLOCATION PROCESSOR FOR THE SCHOOL SIMULATION
VEHICLE PILOT VERSION.

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A DESCRIPTION WAS PRESENTED OF A SIMULATION VEHICLE THAT
WAS BEING DEVELOPED TO PERMIT MODELING ANY SCHOOL
CONFIGURATION. THE MODEL WAS CONSIDERED AS HAVING TWO MAJOR
PARTS--(1) THE ACTIVITY PROCESSOR AND (2) THE RESOURCE
ALLOCATION PROCESSOR. THE ADDITION OF THE RESOURCE ALLOCATION
PROCESSOR TO THE PREVIOUSLY DEVELOPED SIMULATION VEHICLE
PROVIDES FOR (1) THE LOGICAL FLOW AND (2) THE THE CAPABILITY
FOR CONTROL OF RESOURCES (PERSONS, PLACES, AND THINGS) BY
ANALYZING THE TERMINATION, CONTINUATION, AND ACTIVATION OF
ACTIVITIES ACCORDING TO THE LOGICAL DEMANDS OF THE SIMULATION
VEHICLE AND THE CURRENT EXPRESSION OF THE SYSTEMS RESOURCE
CAPABILITIES. FLOWCHARTS OF THE RESOURCE ALLOCATION PROCESSOR
ARE INCLUDED. RELATED REPORTS ARE ED 010 559 AND ED 010 577
THROUGH ED 010 581. (AL)

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The views, conclusions, and recommendations contained herein do not necessarily reflect the official views or policies of the System Development Corporation or agencies of the United States Government

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TECHNICAL

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a working paper

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Resource Allocation Processor for the
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Office of Education

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Pilot Version

by

Frank A. Yett

TM-1409, "Construction of a Simulation Vehicle" (6 August 1963), describes a general vehicle that will permit modeling any school configuration. The vehicle including charts and verbal descriptions, shows the logical flow and control of activities which faculty, staff and students perform. The vehicle described in TM-1409 does not include the control of resource or time. Computer programs using this description are called the Pilot Version Mod 1 and that part of the model included in Mod 1 is called the Activity Processor.

The description of the simulation vehicle in the present document includes considerations of time and resource control. The simulation vehicle is here considered as a model with two major parts: the Activity Processor and the Resource Allocation Processor. As yet, it does not include an "Information Processor," to formally effect control of data input and output, format, analysis, and processing. At present, the necessities of data processing and record keeping are included ad hoc in the computer versions of the model.

Resource Allocation Processor

Addition of the Resource Allocation Processor to the simulation vehicle provides the logical flow and the capability for control of resources (persons, places and things) with appropriate regard to timing. It analyzes termination, continuation and activation of activities according to the logical demands of the simulation vehicle and the current expression of the system's resource capabilities. It is described in Figures 1-3 in the Appendix.

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Timing

Time duration in the simulation vehicle is expressed on two time scales. The one for the Activity Processor is a series of time units, logically connected end to end, ad infinitum. All activities begin at the start of a time unit and terminate at the end of a time unit. From its beginning to its end, an activity is said to be underway. During the time in which the activity is being performed, the resources engaged by the activity undergo no change. All change in resources takes place at the completion of the activity.

The Resource Allocation Processor operates on a time scale considered as a series of "suspended" or "null" periods interspersed between successive time units of the Activity Processor. During each such null period the model is reconstituted so that all completed activities are deleted from the Activity Processor. Since the logical expression of the simulator requires a next activity for each student who has been released from a terminated activity, new next activities are made ready, as necessary, for possible activation in the next time unit of the Activity Processor. If the next activity for a released student requires only one student, that next activity is made ready by the Resource Allocation Processor. If the next activity requires more than one student, such a next activity is made ready unless an appropriate next activity which has previously been made ready can accommodate additional students in queue.

Logical and Physical Presence

In the view of the simulator, each activity taking place requires the "presence" of a student in queue. Since many activities in the system are done for or because of the student, rather than with or by the student, the "presence" of a student can be either a logical state or a physical state. In a logical state, the activity is appropriate as an expression of service to the student. In a physical state, the student must physically participate as part of the system.

This presence of the student in an activity, being either logical or physical, has no bearing on the state of presence required of him by the next activity. Either state of presence in one activity may be followed, through application of the distribution rules imposed, by either a logical or physical state in the queue of a next activity.

Classification of Activities and Activity Processor Lists

The Activity Processor includes all the activities necessary to express the simulation during any time unit, i. These activities represent a subset of all possible activities which the simulation vehicle implies by reason of its logical expression.

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All the activities in the Activity Processor during any time unit, *i*, are considered to be on the:

Active List, all those activities underway during time unit *i*

or the

Dormant List, made up of all those activities which have been made ready by the Resource Allocation Processor prior to the beginning of time unit *i*, but which are not underway, including:

- 1) Activities requiring only one student, with one student in queue,
 - a) As required (logically or physically), but without sufficient resources otherwise.
 - b) Logically present, but physically required, with or without sufficient resources otherwise.
- 2) Activities requiring more than one student.
 - a) With one or more students in queue, but with insufficient number of students in queue, with or without sufficient resources otherwise.
 - b) With a sufficient number of students in queue.
 - 1) Some of which are logically present but physically required, with or without sufficient resources otherwise.
 - 2) All of which are present as required (logically or physically) without sufficient resources otherwise.

Any activity requiring the logical presence of only one student can always be placed underway if the system's resource capability is adequate and criteria governing priority of execution are otherwise satisfied.

Mod 2 and Mod 3 of the Pilot Version

The first combination of the Activity Processor and the Resource Allocation Processor, with provision for expressing the two as part of a system, is named Pilot Version Mod 2.

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Mod 2 includes the Activity Processor and an attenuated version of the Resource Allocation Processor. Charts for Mod 2 are shown by Figures 4 and 5 in the Appendix.

In Mod 2 all activities have a time duration of only one time unit.

The assignment of one or more time units for the time duration of activities in the model will be a modification of this time control feature. This modification of Mod 2 is called Pilot Version Mod 3. In Mod 3, the time unit used by the Activity Processor is set at 1/8 of an hour. Figures 6 and 7 illustrate Mod 3.

In Mod 2 and Mod 3 of the Pilot Version the only resource demand modifying the model's operation is the student resource. The student(s) must be present in queue for the activity to be made ready. If the number of students necessary for the activity is in queue, that activity will be placed underway.

Since the demand for the student may be either logical or physical, an activity requiring physical presence could not ordinarily be placed underway if some other activity requiring physical presence had engaged the student. The number of logical states, however, would be limited only by the system's capability for providing activities.

In Mod 2 and Mod 3, the difference between the logical and physical state is not made. The system and the student are assumed to have the time and the capability for effecting whatever activities the logical expression of the model demands. As a result of this and the further assumption that there is no resource demand other than the appropriate number of in queue students, the Dormant List of the Activity Processor in Mod 2 and Mod 3 will include only those activities classified under 2a in the Dormant List description given above.

In Mod 2 and Mod 3, therefore, any activity requiring but one student is immediately made ready by the Resource Allocation Processor whenever the logical expression of the simulator releases a student from a terminated activity and distributes the student to a next activity.

Classification of Activities and Resource Allocation Processor Lists

At the end of time unit 1, the Activity Processor operation is suspended, and the Resource Allocation Processor is activated.

All the activities listed on the Dormant List, time unit 1, are transferred to the:

Interim List, made up of all those activities which may be placed underway in the next time unit, $i+1$, provided in queue, resource and priority criteria are met.

All the activities on the Active List, time unit i , are reviewed. Those activities which have not been terminated with the end of time unit i are transferred to the:

Continuation List, which is made up of all those activities which will continue underway during time unit $i+1$.

In Mod 2, since all activities have a time duration of one time unit, no Continuation List of activities is included in the Resource Allocation Processor. All activities underway in time unit i will be deactivated at the end of time unit i . For this reason the Continuation List is deleted from the Mod 2 charts.

Since Mod 3 provides for time durations of one or more time units, the Continuation List is included in its Resource Allocation Processor.

Those activities which have been terminated with the end of time unit i , are transferred to the:

Deactivate List, which includes all those activities which have been terminated at the end of time unit i .

The Resource Allocation Processor releases resources of deactivated activities to inventory and distributes students in the out queue of each activity to the "next" activities by applying the queue distribution rules. If a required next activity is not already on the Interim List (transferred from the Dormant List, time unit i), such an activity is made ready and placed on the:

Make-Ready List, of all those activities required by the distribution of students from deactivated activities, but which have not been previously made ready.

The activities on the Make-Ready List are transferred to the Interim List which has previously received activities from the Dormant List, time unit i , thus completing the Interim List. Then the Resource Allocation Processor analyzes the activities of the Interim List for in queue requirements. Activities on the Interim List which cannot be placed underway by reason of insufficient in queue students, or the necessity for the physical presence of an unavailable student, are placed on the Dormant List, time unit $i+1$.

Those activities on the Interim List which have the requisite in queue students are placed on the:

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Priority List, made up of all those activities, with requisite in queue students, arranged according to the priority rules for placing activities on the Priority List.

The system resource capability is reviewed for the resource demands of each activity on the Priority List, in order of the priority established. All those activities for which the system cannot supply the required resources are placed on the Dormant List, time unit $i+1$.

Those activities which the system can supply with the required resources are placed on the:

Go List, made up of all those activities which can be placed underway beginning time unit $i+1$.

In Mod 2 and Mod 3, since all required resources other than students are presumed to be available at any time, activities placed on the Priority List cannot be subsequently diverted to the Dormant List for the reason of insufficient resources. In effect, the entire Priority List is transferred to the Go List.

For this reason, the logical flow of activities from the Priority List to the Dormant List is deleted from the Mod 2 and Mod 3 charts.

The Go List and the Continuation List are combined to form the Active List, time unit $i+1$.

The Resource Allocation Processor is then deactivated and the Activity Processor is activated for time unit $i+1$. All the activities on the Active List, time unit $i+1$, are placed underway. The cycle of resource allocation analysis based on the simulation of time unit i is complete.

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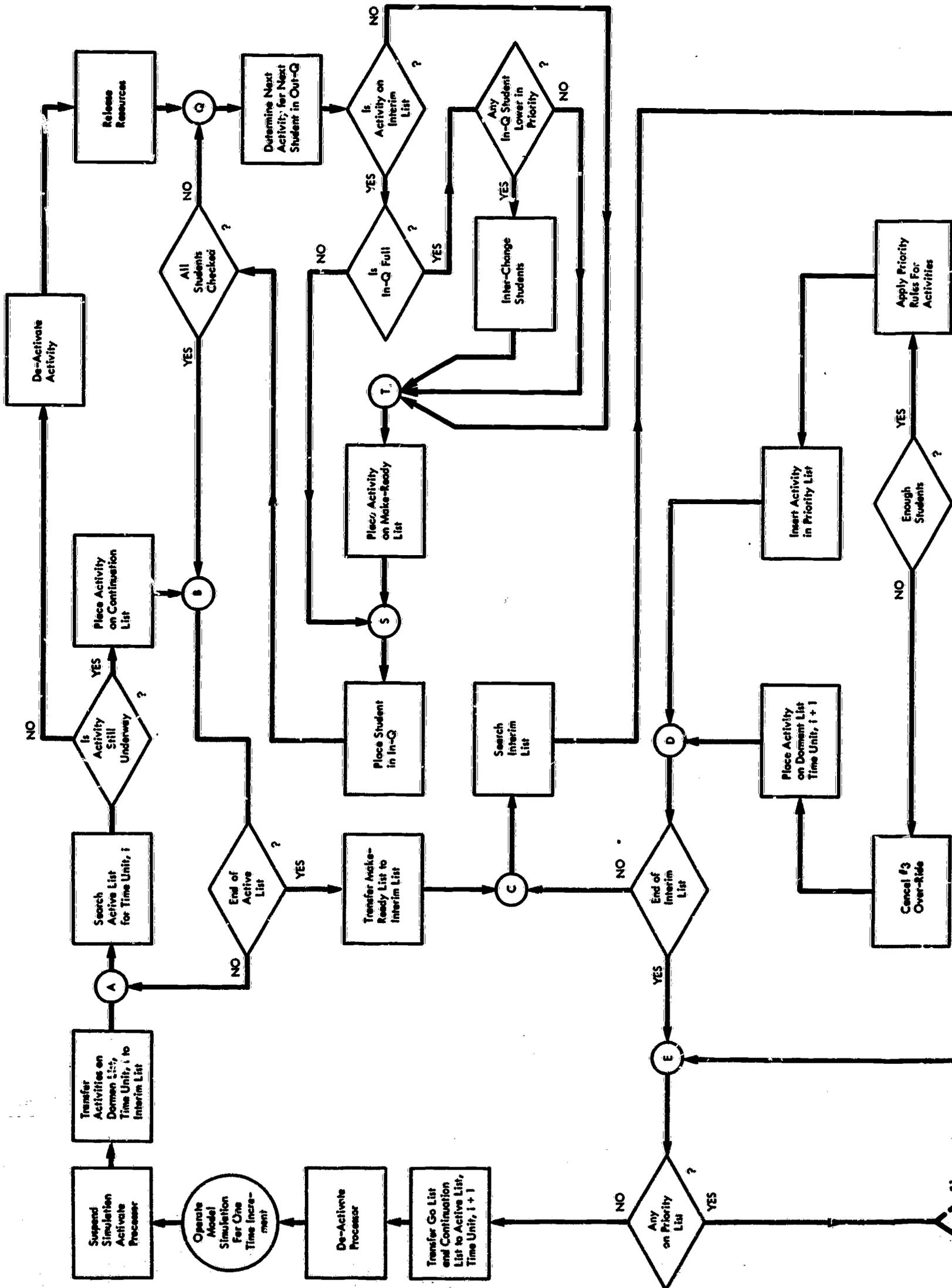
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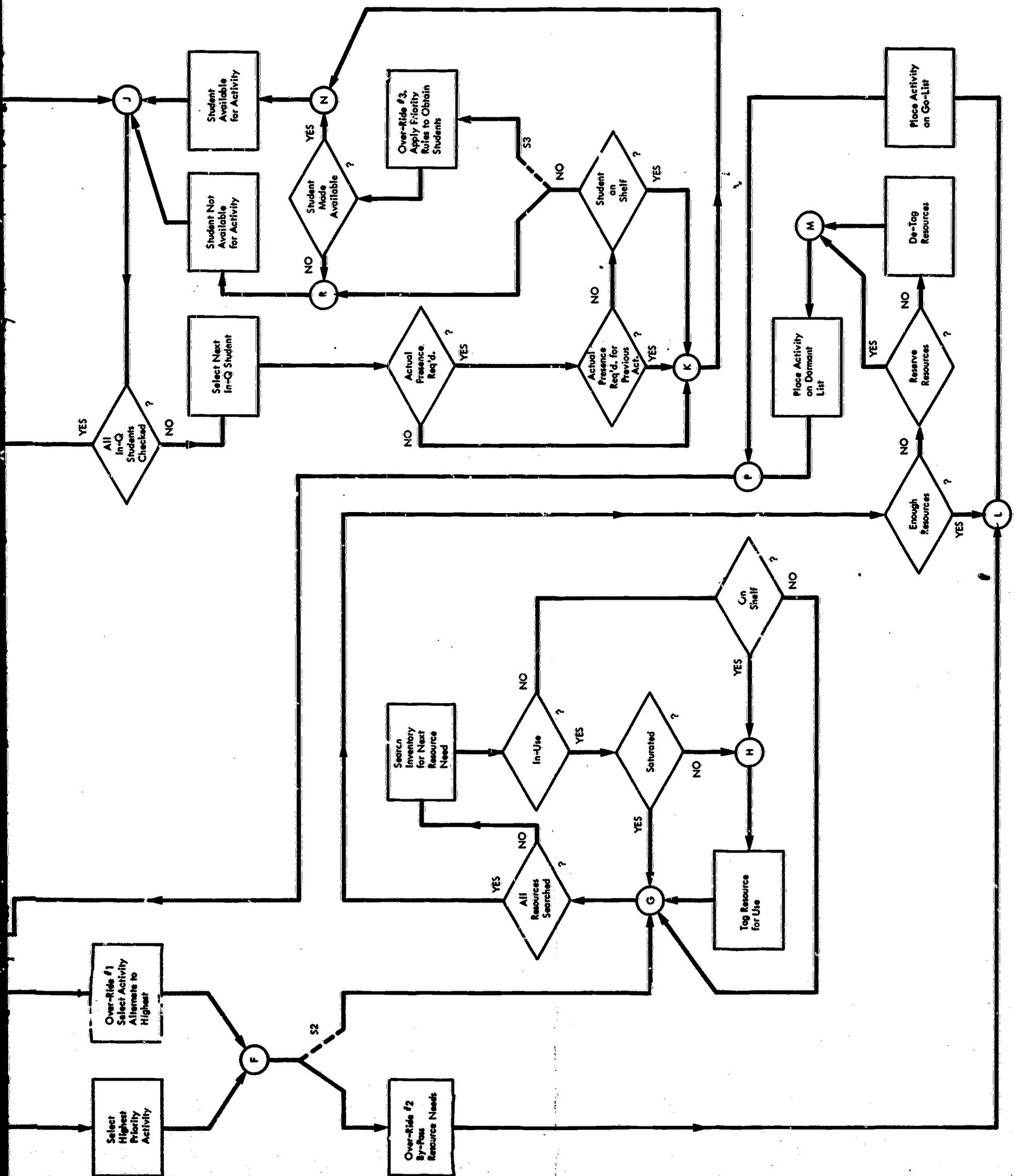
APPENDIX

Flow charts

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FIGURE 1. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION





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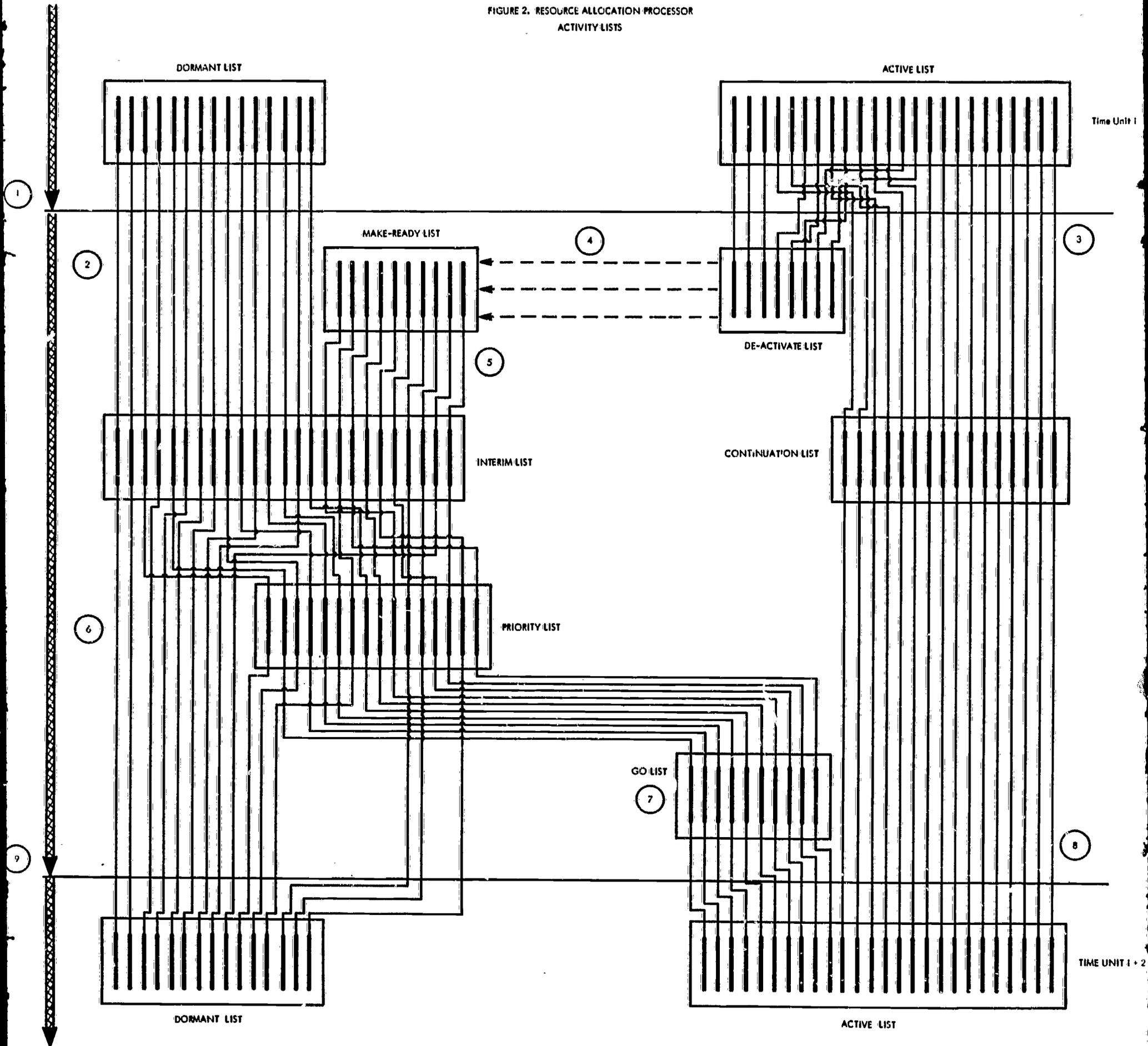
FIGURE 2. RESOURCE ALLOCATION PROCESSOR
ACTIVITY LISTS

| STEP | DESCRIPTION | NAME OF LIST | NUMBER OF ACTIVITIES ON LIST |
|------|--|--------------------------------|------------------------------|
| 1. | De-Activate Activity Processor; activate Resource Allocation Processor. | Dormant List, i | L1 |
| 2. | Transfer activities on Dormant List, time unit, i, to Interim List. | Active List, i | L2 |
| 3. | Search Active List; Transfer activities not yet terminated to Continuation List; transfer activities terminated to De-Activate List. | De-Activate List | L3 |
| 4. | Prepare Make-Ready List from Q-distribution of activities on De-activate List. | Continuation List | L4 |
| 5. | Transfer activities on Make-Ready List to Interim List. | Make-Ready List | L5 |
| 6. | Search Interim List; transfer activities with required in-Q students to Priority List under priority criteria; transfer activities without required in-Q students to Dormant List, time unit, i + 1. | Interim List | L6 |
| 7. | Search Priority List; transfer activities supplied without required resources to Go List; transfer activities without required resources to Dormant List, time unit, i + 1. | Priority List | L7 |
| 8. | Transfer activities on Go List and Continuation List to Active List, time unit, i + 1. | Go List | L8 |
| 9. | De-activate Resource Allocation Processor; activate Activity Processor. | Active List, i + 1 | L9 |
| | | Dormant List, i + 1 | L10 |
| | | $L9 + L10 = L1 + L2 - L3 + L5$ | |
| | | $L2 = L3 + L4$ | |
| | | $L6 = L1 + L5$ | |
| | | $L9 = L4 + L8$ | |
| | | $L10 = L6 - L8$ | |

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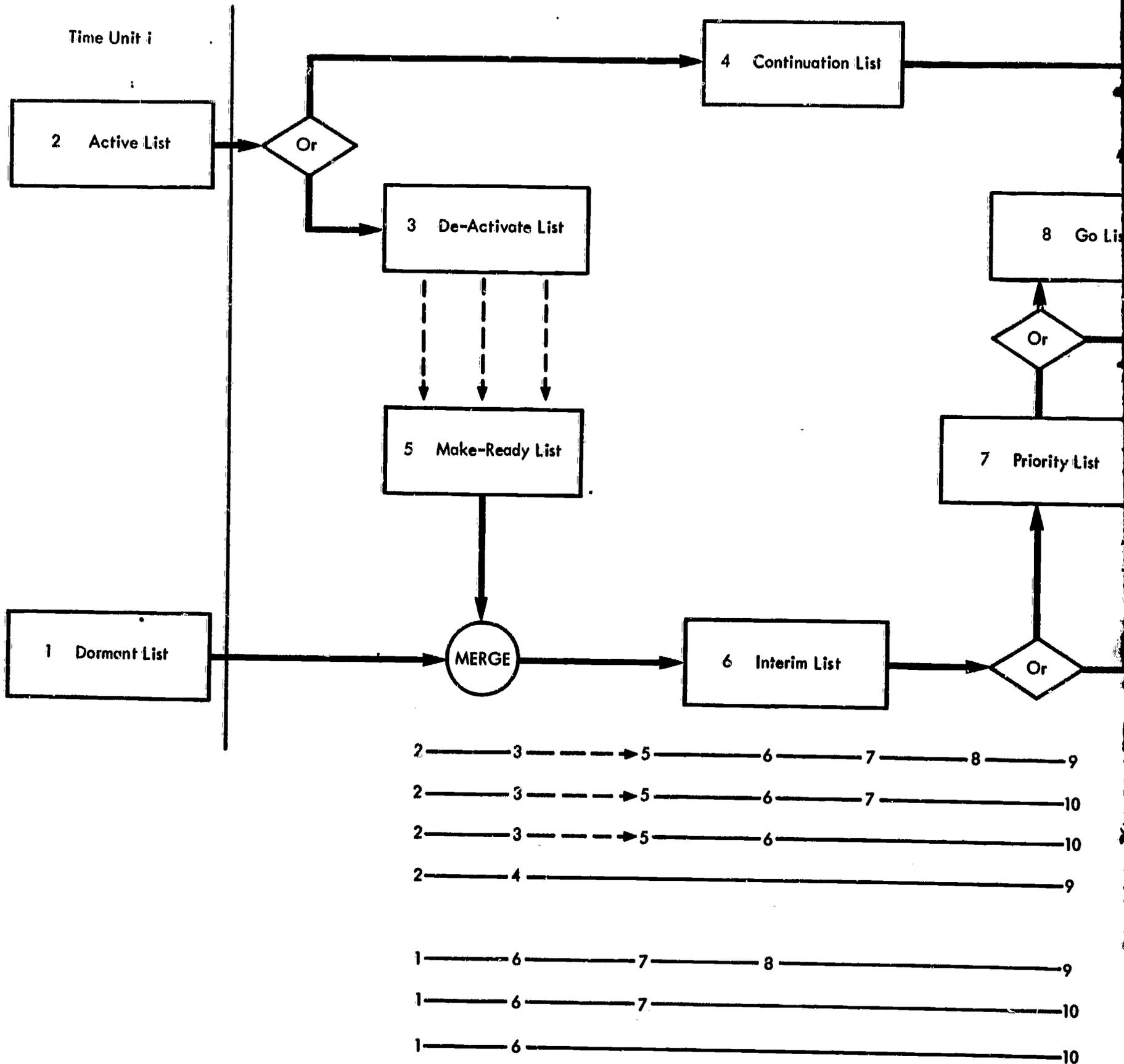
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FIGURE 2. RESOURCE ALLOCATION PROCESSOR
ACTIVITY LISTS

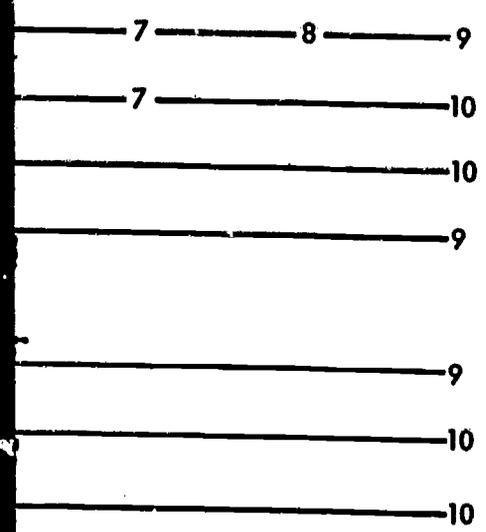
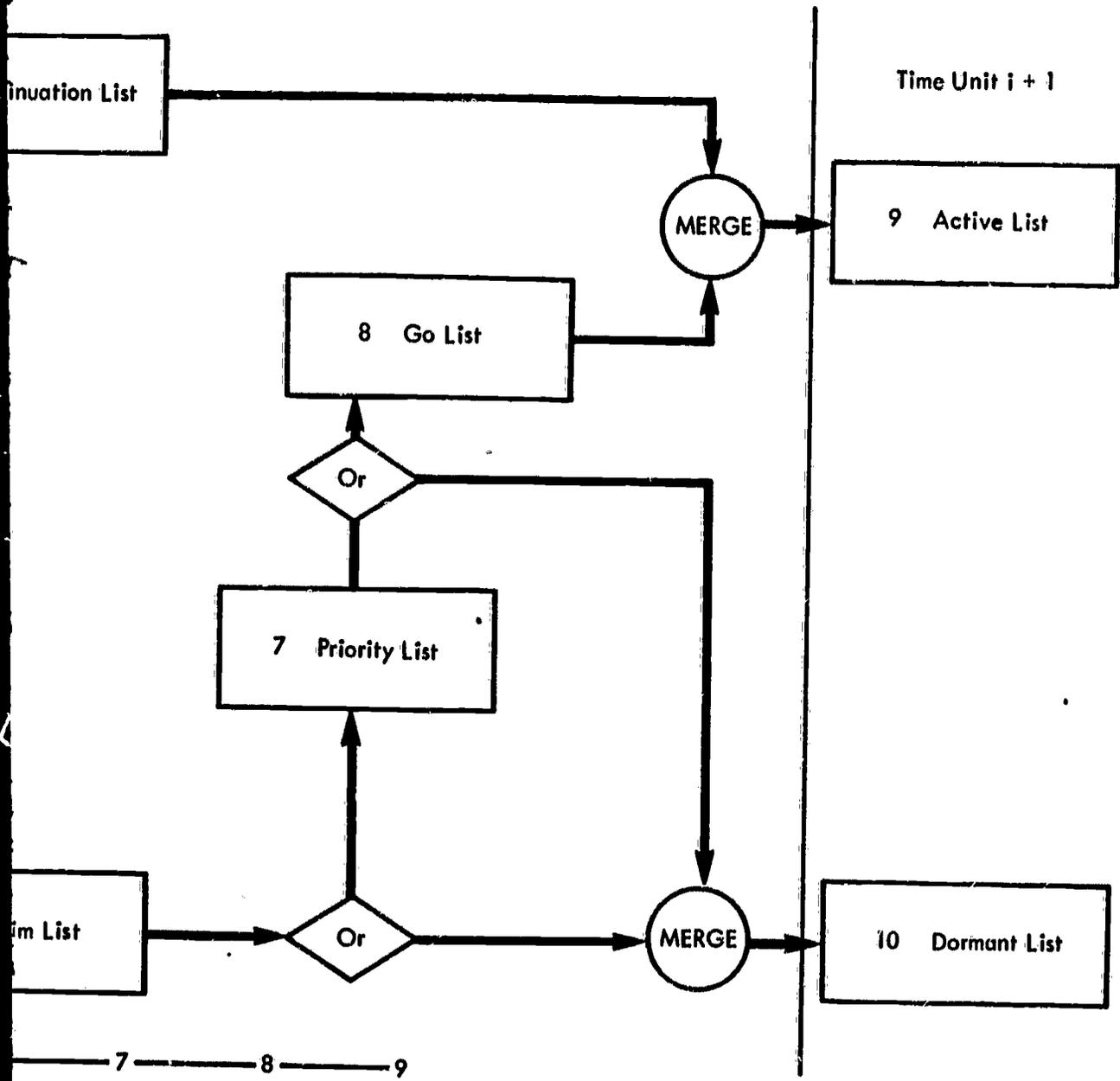


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FIGURE 3. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION
LOGICAL FLOW OF ACTIVITIES

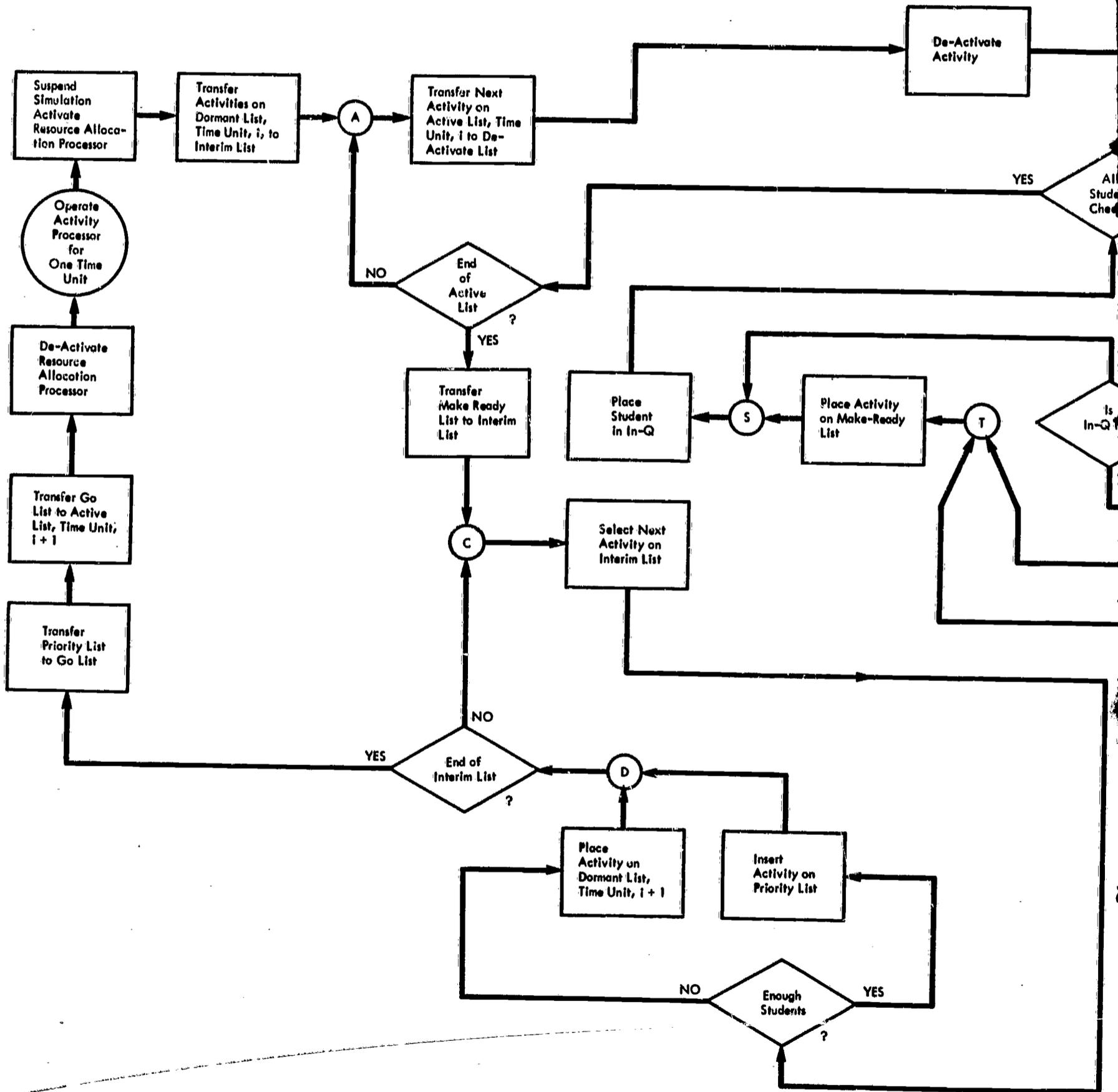


ALLOCATION PROCESSOR
PILOT VERSION
FLOW OF ACTIVITIES



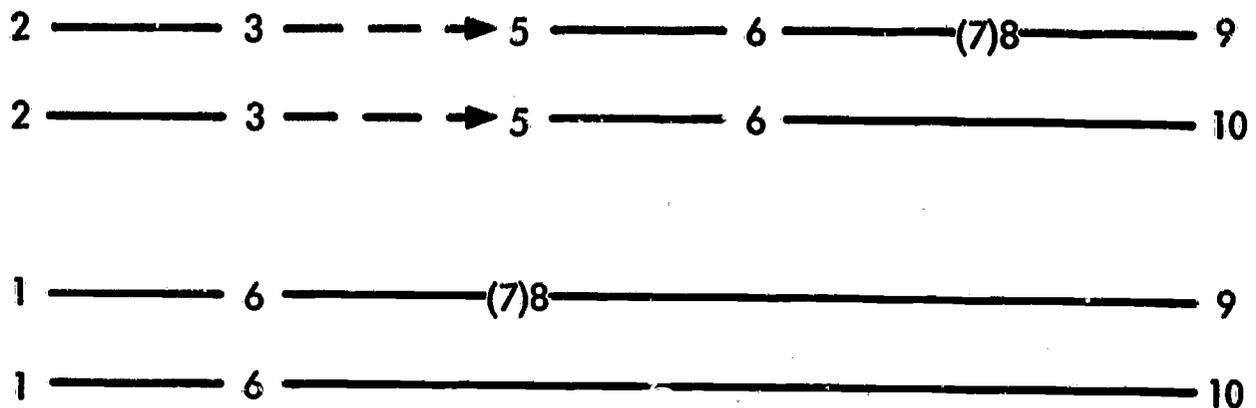
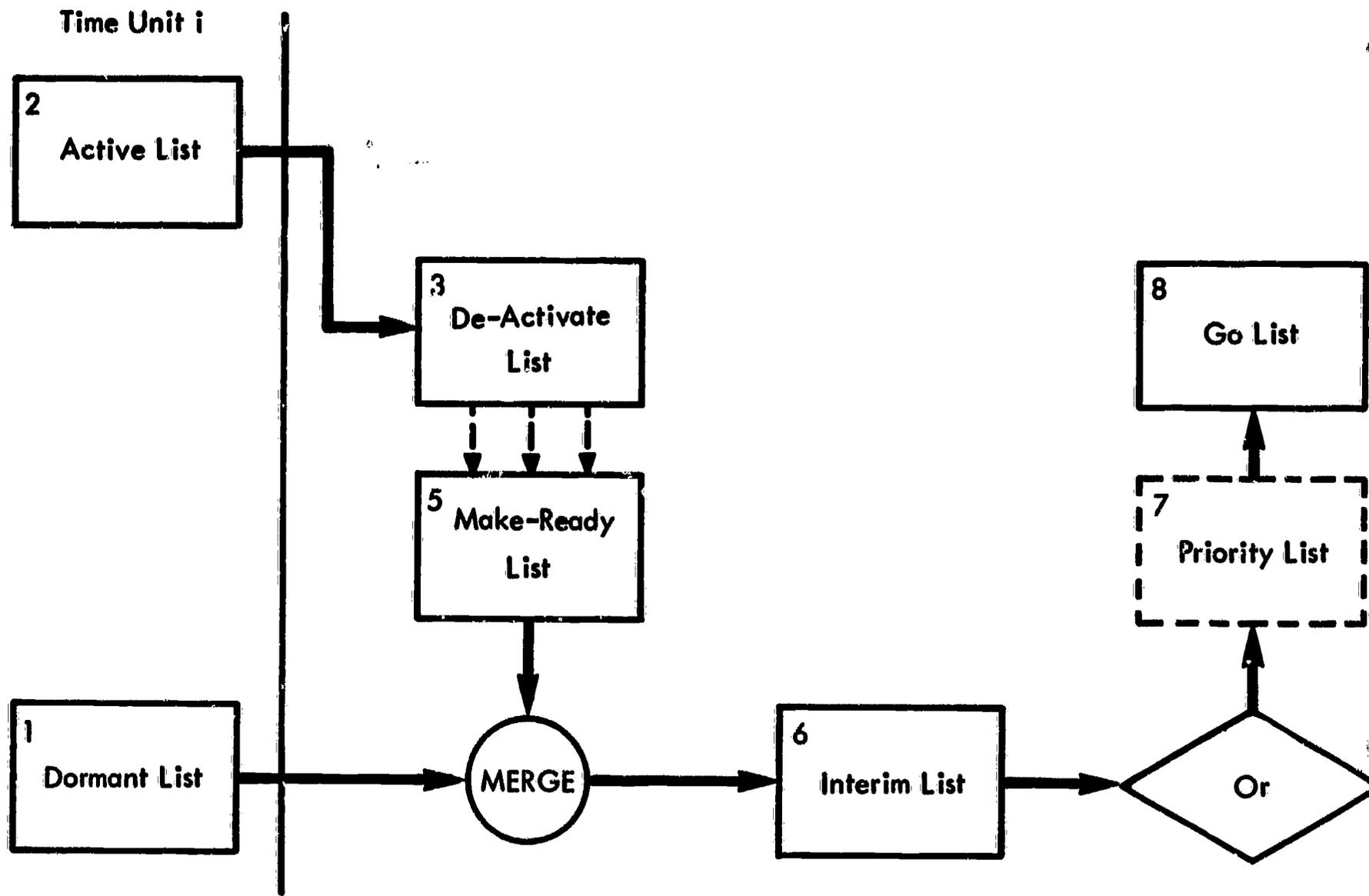
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FIGURE 4. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 2

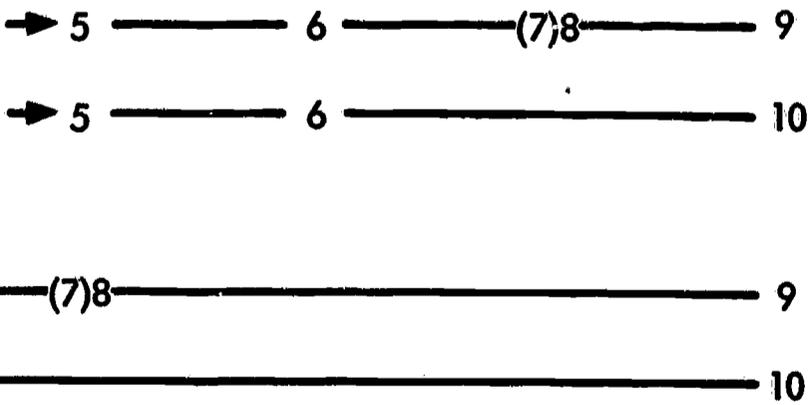
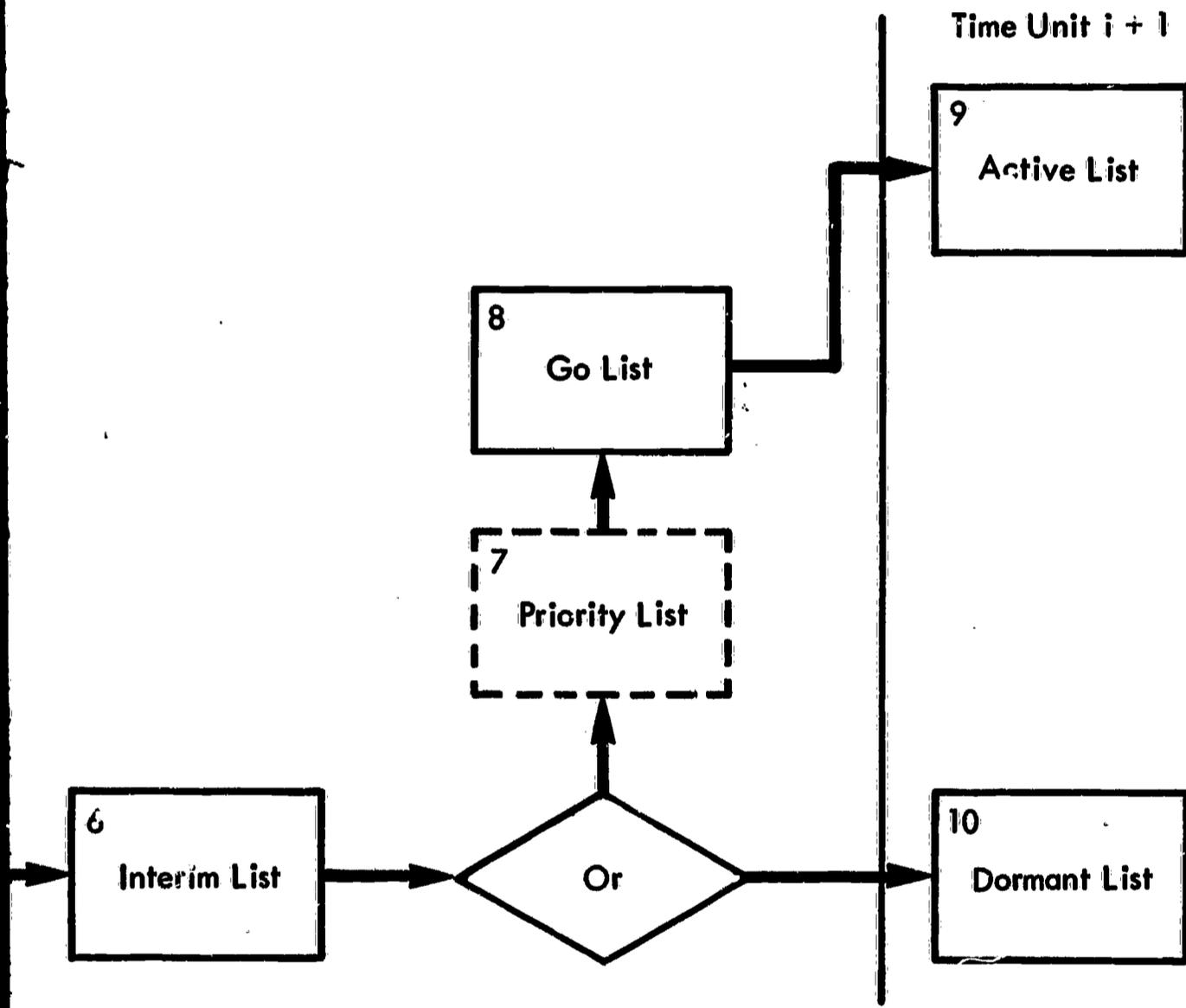


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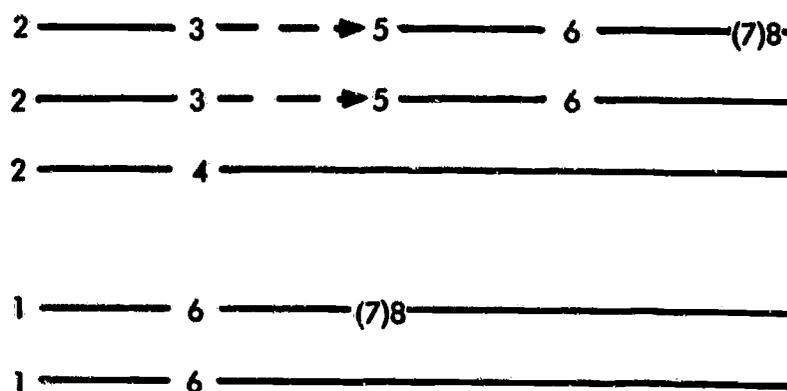
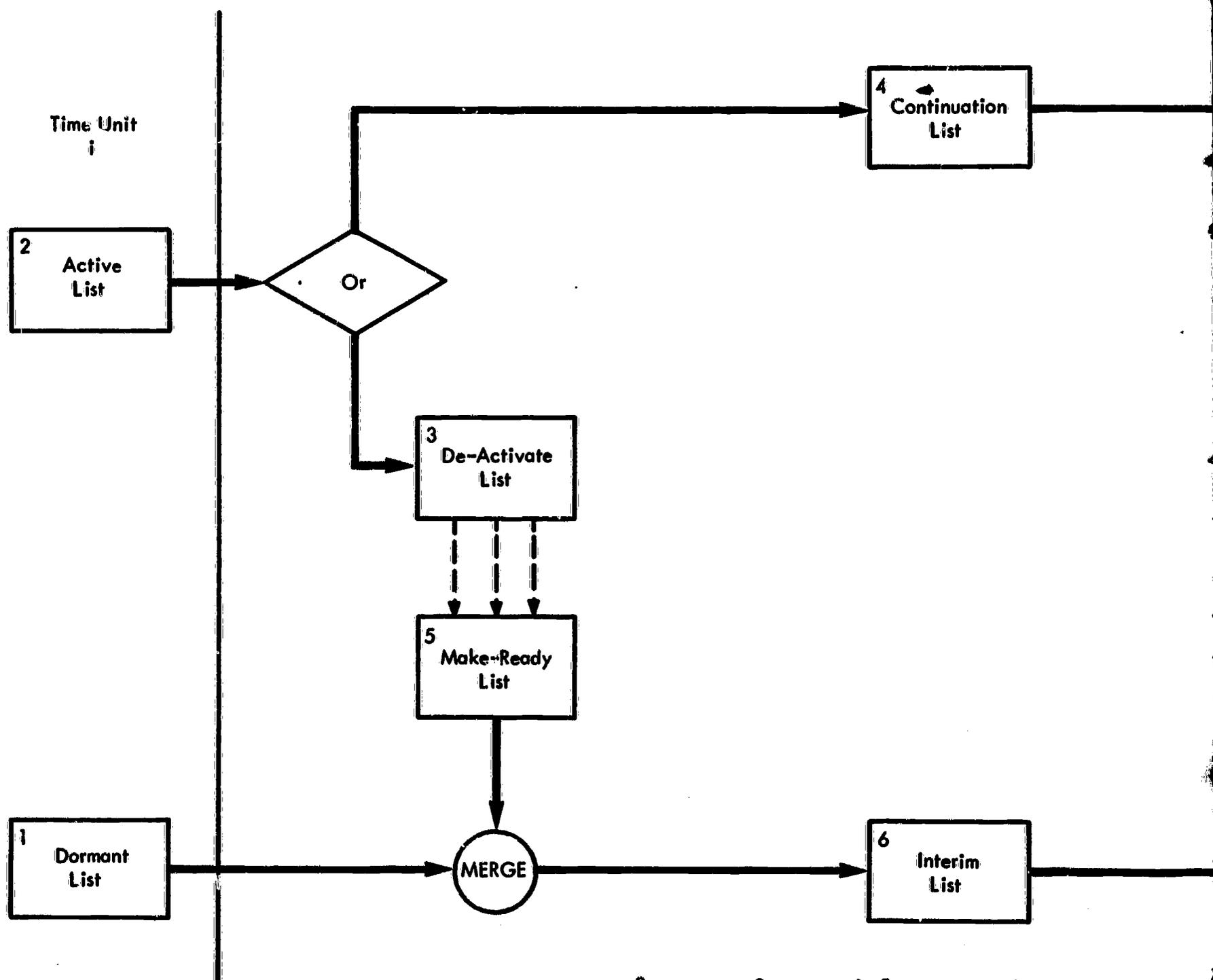
FIGURE 5. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 2
LOGICAL FLOW OF ACTIVITIES



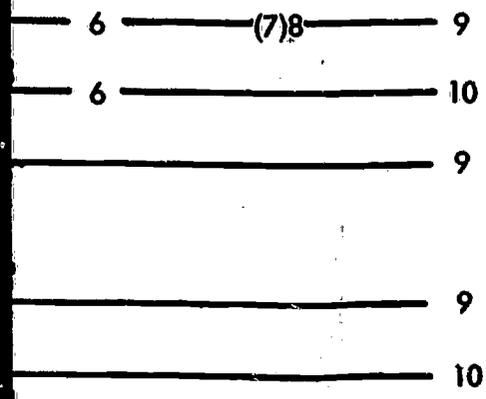
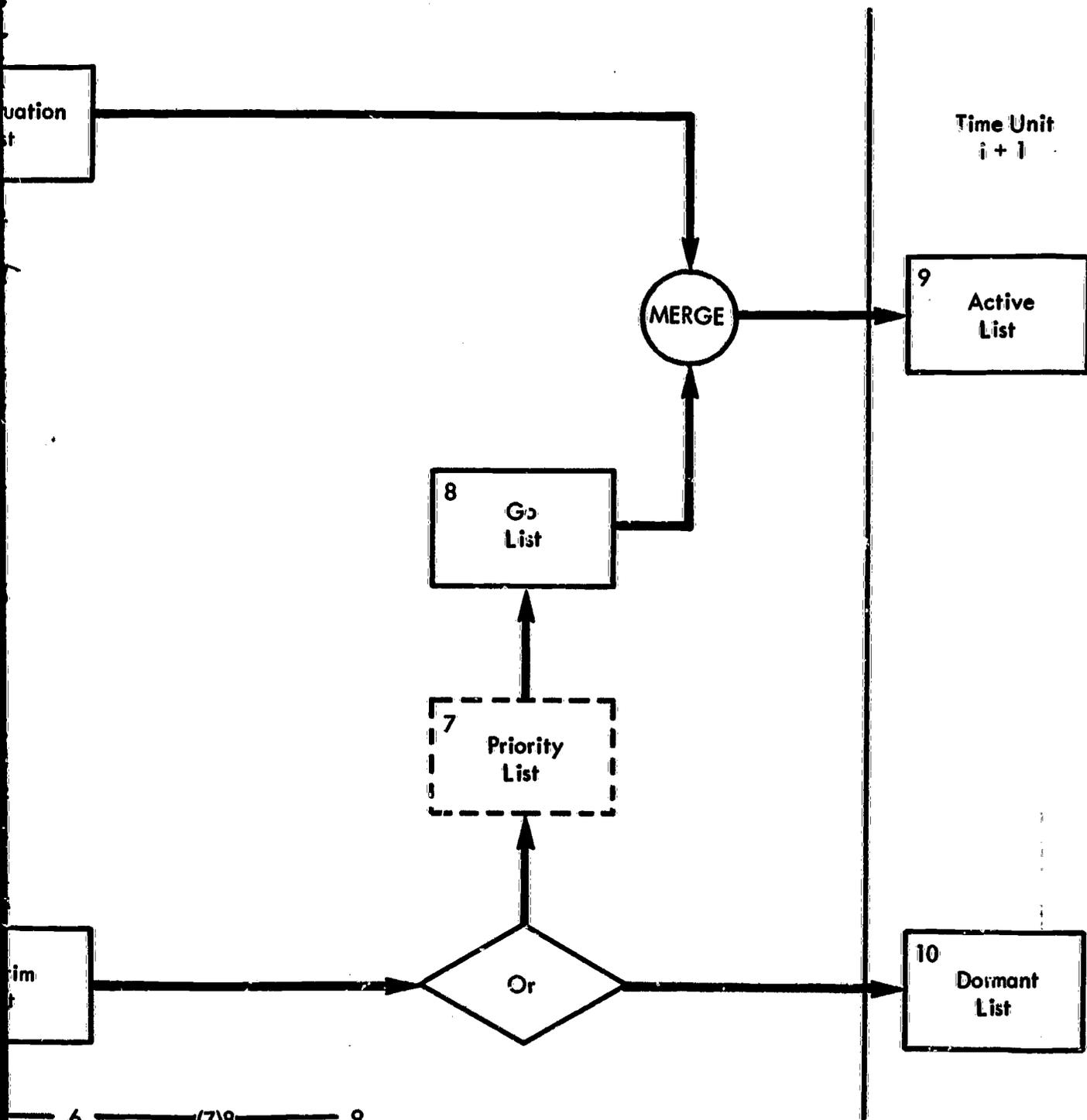
RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 2
LOGICAL FLOW OF ACTIVITIES



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FIGURE 6. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 3
LOGICAL FLOW OF ACTIVITIES



ALLOCATION PROCESSOR
VERSION MOD 3
FLOW OF ACTIVITIES



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FIGURE 7. RESOURCE ALLOCATION PROCESSOR
PILOT VERSION MOD 3

