GASP IV TUTORIAL

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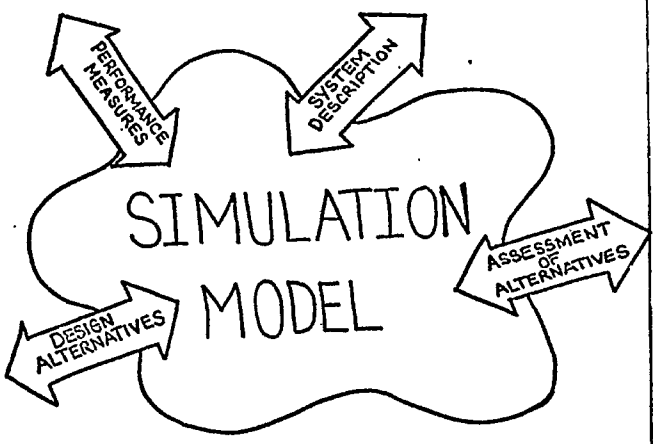
This paper presents a select set of slides that will be presented in the tutorial on GASP IV. Complete documentation for GASP IV is currently available (1,2) and does not need to be reproduced in these proceedings.

1. Pritsker, A. A. B., The GASP IV Simulation Language, New York: John Wiley & Sons, Inc., 1974.

2. Pritsker, A. A. B., The GASP IV User's Manual, Pritsker & Associates, Inc., 1710 South St., Lafayette, Indiana 47904, 1974.

SLIDE 1. AN APPROACH TO SIMULATION MODELING



SLIDE 2. THE TASKS OF A SIMULATION PROJECT

Deciding to Simulate

Building a Simulation Model

Writing a Simulation Program

Using the Simulation Program for Problem Resolution

SLIDE 3. WHAT DOES GASP IV PROVIDE?

Automatic Time Advance

Event Scheduling and Control

Continuous Variable Integration with Variable Step Size and User Specified Accuracy Requirements

Discrete-Continuous Interaction Procedures

Statistical Data Collection

Random Deviate Generation

Program Monitoring and Error Reporting

Information Storage and Retrieval

Automatic Statistical Computation and Reporting

Standardized Simulation Reports

Tabular and Plotted Histograms

Automatic Plotting Routines

Built-in User Flexibility in Output Reports and Other Provided Functions

SLIDE 4. ADVANTAGES OF GASP IV

Allows Discrete-Continuous Modeling

FORTRAN Based

Modular

Ease of Learning

Ease of Modifying and Extending

SLIDE 5. BASIC SIMULATION CONCEPTS

System Status Representation

Events

Time Advance Procedures

Data Collection and Analysis

SLIDE 6. COMBINED SIMULATION TERMINOLOGY

Time-Events

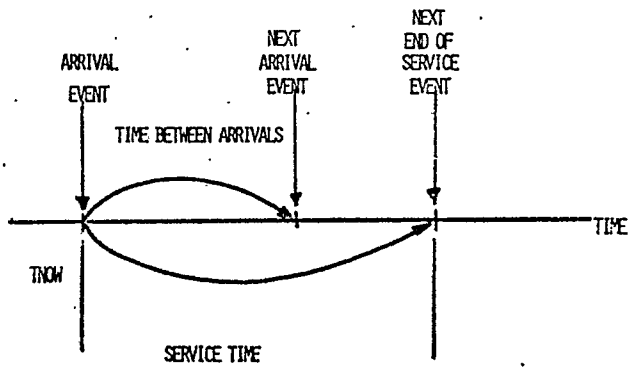
State-Events

Time Advance

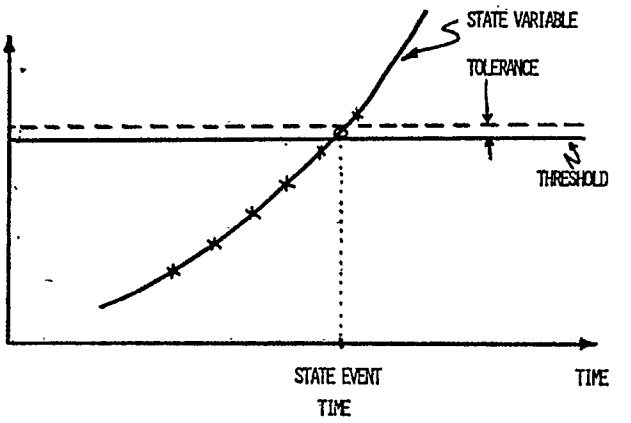
Discrete-Continuous Interactions

- Discrete Changes in State Variables
- Initiation of Time-Events Based on Values of State Variables
- Changing Equation Forms Based on State- and/or Time-Events

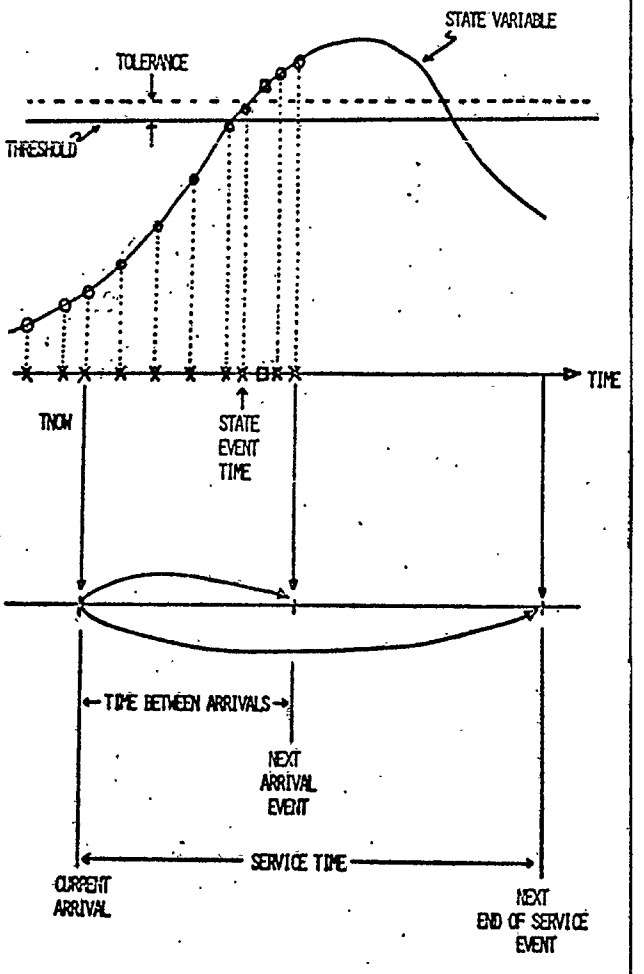
SLIDE 7. TIME-EVENT ILLUSTRATION



SLIDE 8. STATE-EVENT ILLUSTRATION

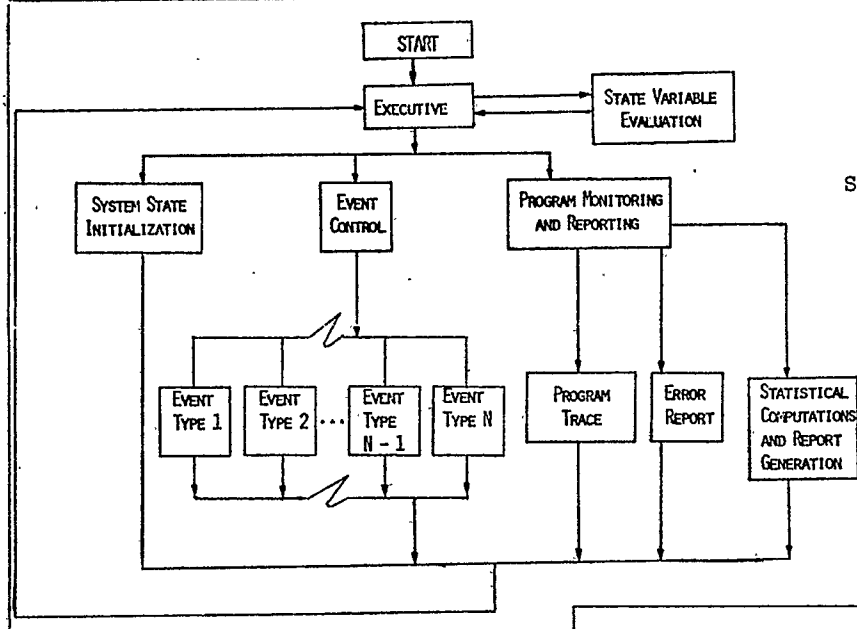


SLIDE 9. TIME ADVANCE PROCEDURE FOR COMBINED SIMULATION

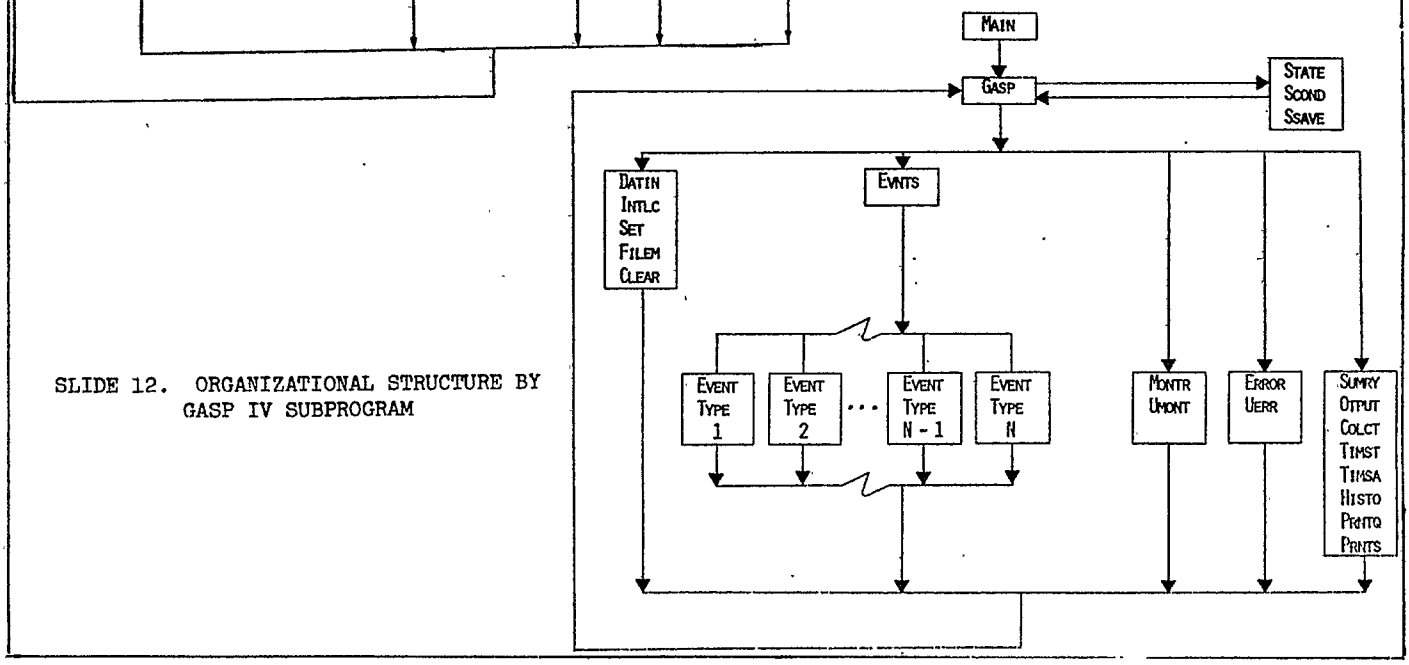


SLIDE 10. CATEGORIZATION OF GASP IV SUBPROGRAMS

Function	GASP IV Provided	User-written
Time advance and status update	GASP	STATE, SCOND, EVNTS, and specific event subprograms
Initialization	DATIN, CLEAR, SET	Main program, INTLC
Data storage and retrieval	FILEM, RMOVE, CANCL, COPY, NPRED, NSUCR, NFIND	
Location of state-events	KROSS	
Monitoring of system simulation	MONTR	UMONT
Error reporting	ERROR	UERR
Data collection and reporting	COLCT, TIMST, TIMSA, HISTO, GPLOT, PRNTQ, PRNTS, SUMRY	SSAVE, OTPUT
Miscellaneous support	SUMQ, PRODQ, GTABL, GDLAY	
Random deviate generation	DRAND, UNFRM, TRIAG, RNORM, ERLNG, GAMA, BETA, NPSSN, EXPON, WEIBL, DPROB	

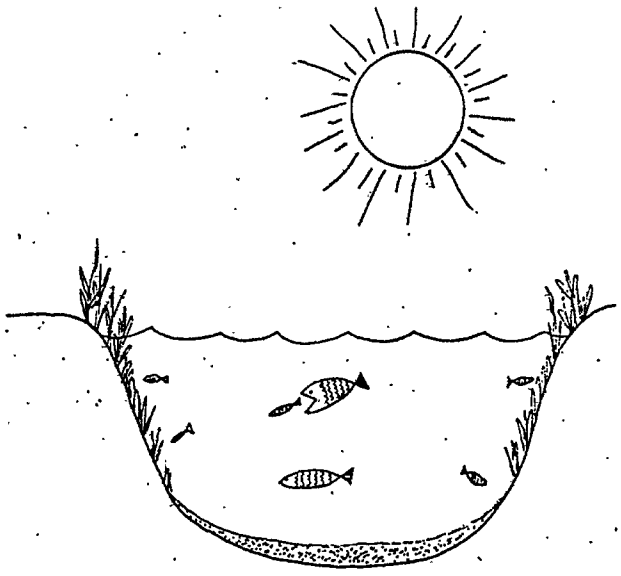


SLIDE 11. ORGANIZATIONAL STRUCTURE OF A GASP IV PROGRAM

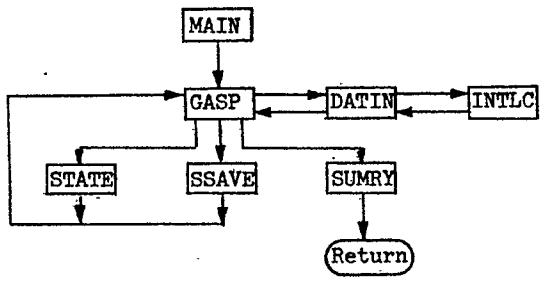


SLIDE 12. ORGANIZATIONAL STRUCTURE BY GASP IV SUBPROGRAM

SLIDE 13. CEDAR BOG LAKE ECOLOGICAL SYSTEM



SLIDE 14. ORGANIZATIONAL STRUCTURE OF GASP IV PROGRAM FOR CEDAR BOG LAKE SIMULATION (CONTINUOUS)



SLIDE 15. DEFINITION OF VARIABLES AND EQUATIONS FOR CEDAR BOG LAKE EXAMPLE

Definition of Variables:

$$DD(I) = \frac{dSS(I)}{dt}$$

$I = 1,5$

SS(1) = Plant Level
SS(2) = Herbivore Level
SS(3) = Carnivore Level
SS(4) = Organic Level
SS(5) = Environmental Level
SS(6) = Solar Transfer Level

System Equations:

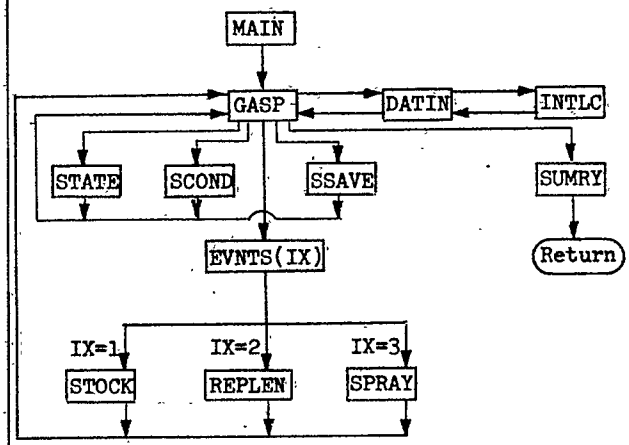
```
SS(6) = 95.9*(1. + .635*SIN(6.28318*TNOW))
DD(1) = SS(6) - 4.43*SS(1)
DD(2) = 0.48*SS(1) - 17.97*SS(2)
DD(3) = 4.85*SS(2) - 4.65*SS(3)
DD(4) = 2.55*SS(1) + 6.12*SS(2) + 1.95*SS(3)
DD(5) = SS(1) + 6.90*SS(2) + 2.70*SS(3)
```

with initial values: SS(1) = 0.83 SS(4) = 0.0
SS(2) = 0.003 SS(5) = 0.0
SS(3) = 0.0001

SLIDE 16. GASP IV PROGRAM FOR CEDAR BOG LAKE -- CONTINUOUS CASE

```
PROGRAM MAIN

NCRDR = 5
NPRNT = 6
CALL GASP
STOP
END

SUBROUTINE INTLC

SS(1) = 0.83
SS(2) = 0.003
SS(3) = 0.0001
SS(4) = 0.0
SS(5) = 0.0
RETURN
END

SUBROUTINE STATE

SS(6) = 95.9*(1. + 0.635*SIN(TNOW*6.28318))
DD(1) = SS(6) - 4.43*SS(1)
DD(2) = 0.48*SS(1) - 17.97*SS(2)
DD(3) = 4.85*SS(2) - 4.65*SS(3)
DD(4) = 2.55*SS(1) + 6.12*SS(2) + 1.95*SS(3)
DD(5) = SS(1) + 6.90*SS(2) + 2.70*SS(3)
RETURN
END

SUBROUTINE SSAVE

CALL GPLOT(SS,TNOW,1)
RETURN
END
```

SLIDE 17. ORGANIZATIONAL STRUCTURE FOR COMBINED GASP IV PROGRAM OF CEDAR BOG LAKE

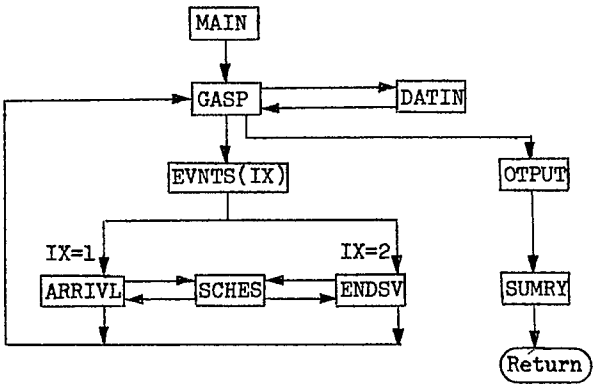


SLIDE 18. GASP IV CODE FOR COMBINED VERSION OF CEDAR BOG LAKE

```
      SUBROUTINE EVNTS(IX)
      GO TO (1,2,3), IX
1     CALL STOCK
      RETURN
2     CALL REPLEN
      RETURN
3     CALL SPRAY
      RETURN
      END

      SUBROUTINE STOCK
      ATRIB(1) = TNOW + 0.1
      CALL FILEM(1)
      SS(3) = SS(3) + 0.3
      RETURN
      END

      SUBROUTINE REPLEN
      SS(2) = SS(2) + 0.2
      RETURN
      END

      SUBROUTINE SPRAY
      ATRIB(1) = TNOW + 0.5
      CALL FILEM(1)
      SS(1) = .70*SS(1)
      RETURN
      END

      SUBROUTINE SCOND
      LFLAG(1) = KROSS(3,0,0.0,0.6,1,0.01)
      RETURN
      END
```

SLIDE 19. A POST OFFICE QUEUEING SITUATION

SLIDE 20. SUBPROGRAM ORGANIZATION FOR QUEUEING SIMULATION



SLIDE 21. PROGRAM MAIN FOR QUEUEING EXAMPLE

```
      PROGRAM MAIN
      NCRDR = 5
      NPRNT = 6
      BUS = 0.0
      CALL GASP
      STOP
      END
```

SLIDE 22. SUBROUTINE ARRIVL FOR QUEUEING EXAMPLE

```
      SUBROUTINE ARRIVL
      ATRIB(1) = TNOW + RNORM(1,1)
      ATRIB(2) = 1.0
      CALL FILEM(1)
      ATRIB(3) = TNOW
      IF(BUS.EQ.0.0) GO TO 10
      CALL FILEM(2)
      RETURN
10    WAIT = 0.0
      CALL COLCT(WAIT,1)
      BUS = 1.0
      CALL TIMST(BUS,TNOW,1)
      CALL SCHES
      RETURN
      END
```

SLIDE 23. SUBROUTINE SCHES FOR QUEUEING EXAMPLE

```
      SUBROUTINE SCHES
      ATRIB(1) = TNOW + TRIAG(2,2)
      ATRIB(2) = 2.0
      CALL FILEM(1)
      RETURN
      END
```

SLIDE 24. SUBROUTINE ENDSV FOR QUEUEING EXAMPLE

```
      SUBROUTINE ENDSV
      TISYS = TNOW - ATRIB(3)
      CALL COLCT(TISYS,2)
      IF(NNQ(2).GT.0) GO TO 50
      BUS = 0.0
      CALL TIMST(BUS,TNOW,1)
      RETURN
50    CALL RMOVE(MFE(2),2)
      WAIT = TNOW - ATRIB(3)
      CALL COLCT(WAIT,1)
      CALL SCHES
      RETURN
      END
```