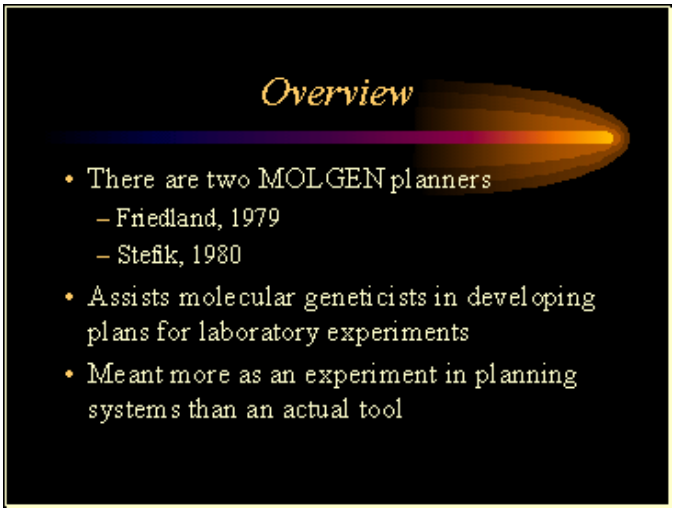
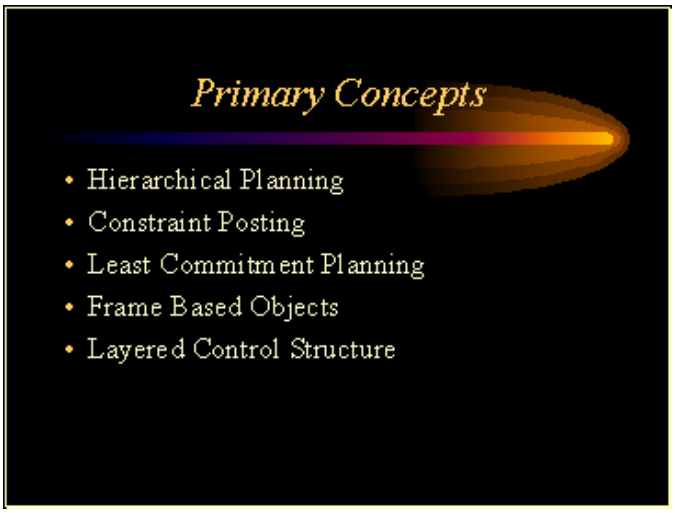
Slide 1

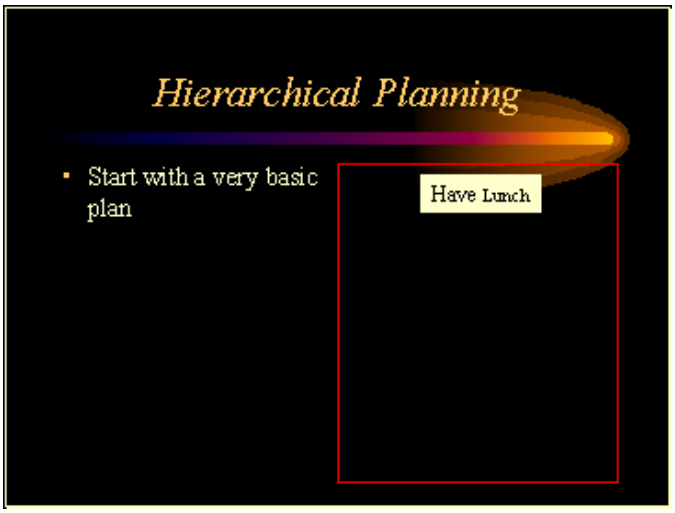
Slide 2


Overview
• There are two MOLGEN planners
– Friedland, 1979
– Stefik, 1980
• Assists molecular geneticists in developing plans for laboratory experiments
• Meant more as an experiment in planning systems than an actual tool

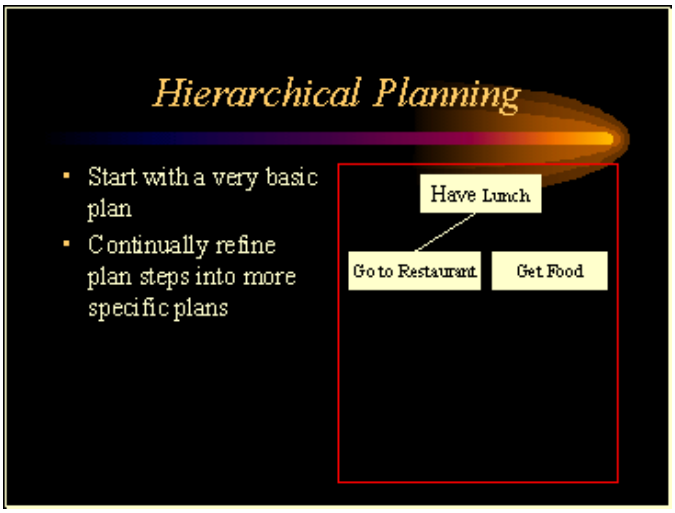
Slide 3


Primary Concepts
• Hierarchical Planning
• Constraint Posting
• Least Commitment Planning
• Frame Based Objects
• Layered Control Structure

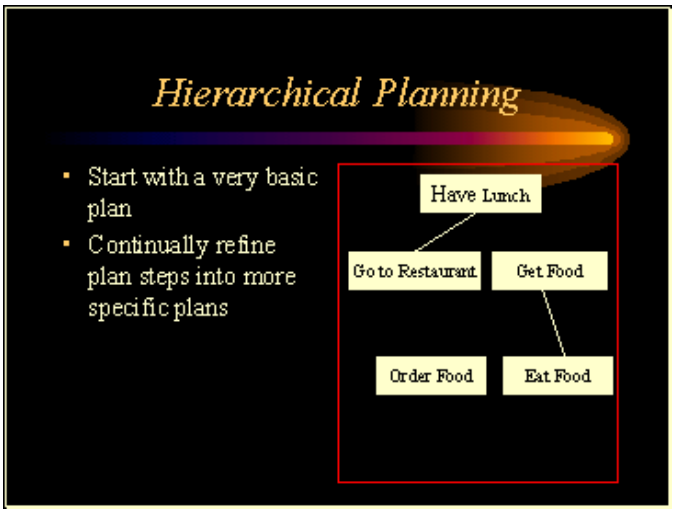
Slide 4


Hierarchical Planning
Start with a very basic plan
Have Lunch

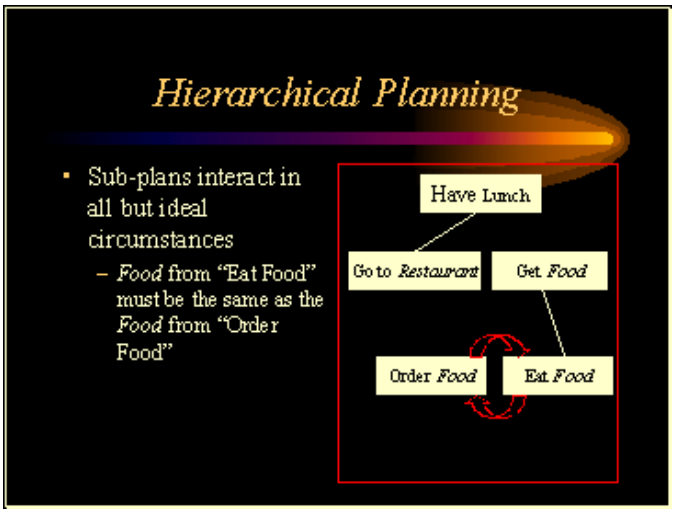
Slide 5


Hierarchical Planning
Start with a very basic plan
Continually refine plan steps into more specific plans
Have Lunch
Go to Restaurant
Get Food

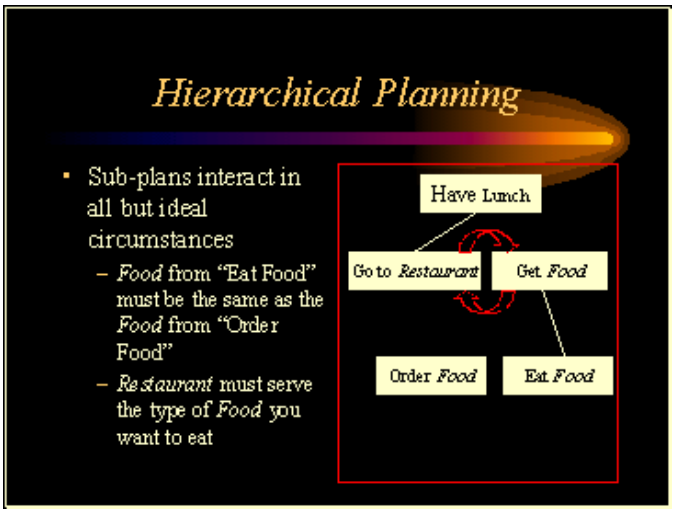
Slide 6


Hierarchical Planning
Start with a very basic plan
Continually refine plan steps into more specific plans
Have Lunch
Go to Restaurant
Get Food
Order Food
Eat Food

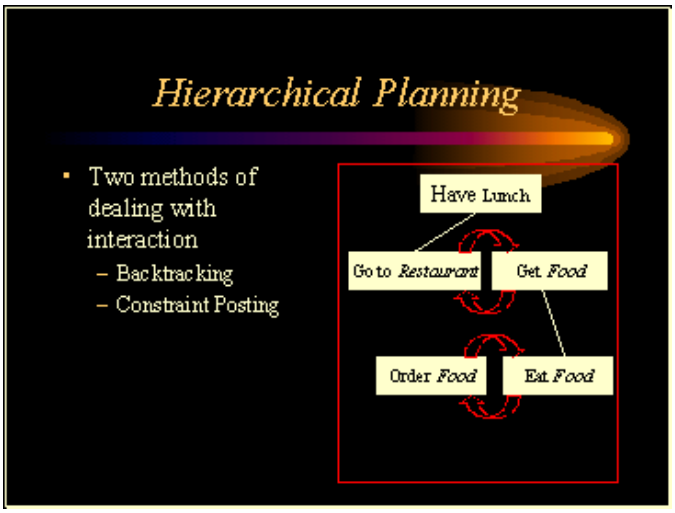
Slide 7


Hierarchical Planning
Sub-plans interact in all but ideal circumstances
– Food from "Eat Food" must be the same as the Food from "Order Food"
Have Lunch
Go to Restaurant
Get Food
Order Food
Eat Food

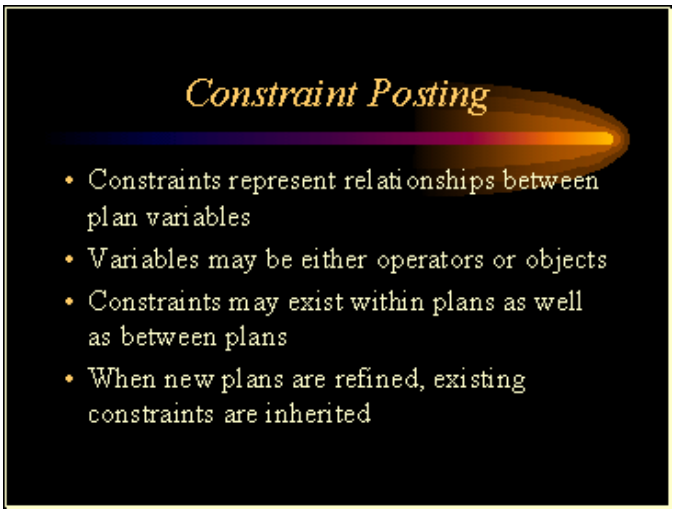
Slide 8


Hierarchical Planning
Sub-plans interact in all but ideal circumstances
– Food from "Eat Food" must be the same as the Food from "Order Food"
– Restaurant must serve the type of Food you want to eat
Have Lunch
Go to Restaurant
Get Food
Order Food
Eat Food

Slide 9


Hierarchical Planning
Two methods of dealing with interaction
– Backtracking
– Constraint Posting
Have Lunch
Go to Restaurant
Get Food
Order Food
Eat Food

Slide 10


Constraint Posting
• Constraints represent relationships between plan variables
• Variables may be either operators or objects
• Constraints may exist within plans as well as between plans
• When new plans are refined, existing constraints are inherited

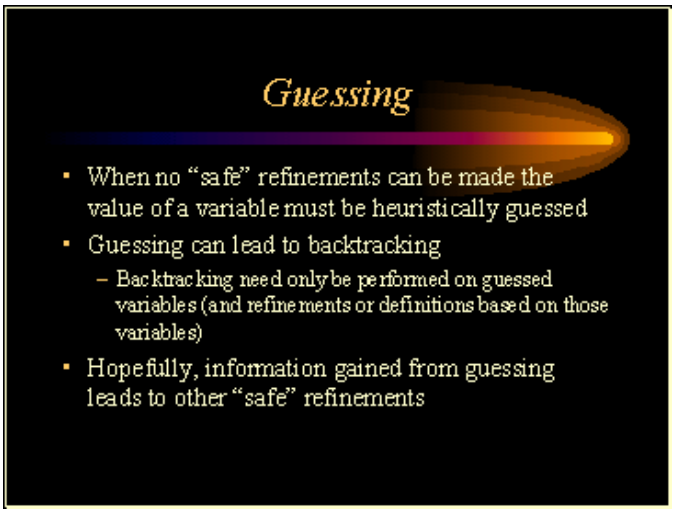
Slide 11

Benefits of Constraint Posting
• Elimination of invalid possibilities
– If Restaurant only serves Italian food, the only possible values of Food are Italian foods
• Partial description of objects
• Expression of relationships between plan variables

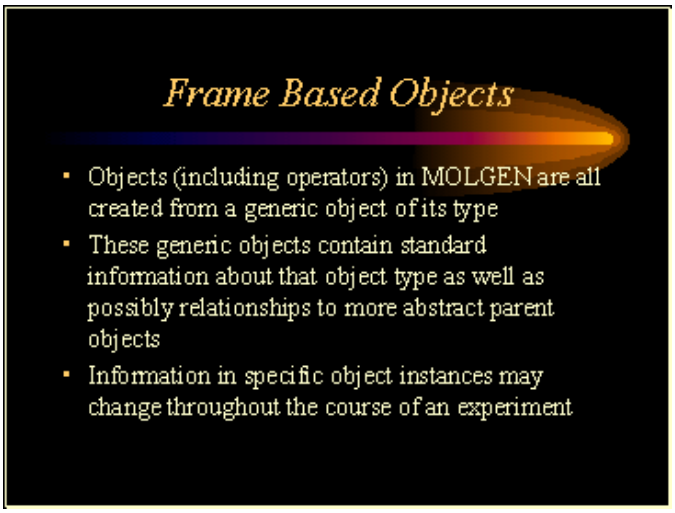
Slide 12

Least Commitment Planning
• Choices about refinement of plans and variables are deferred as long as possible
• When decisions are made, the valid options for other variables decrease
• Further constraints may be discovered
• Choices made under least commitment are never "wrong"

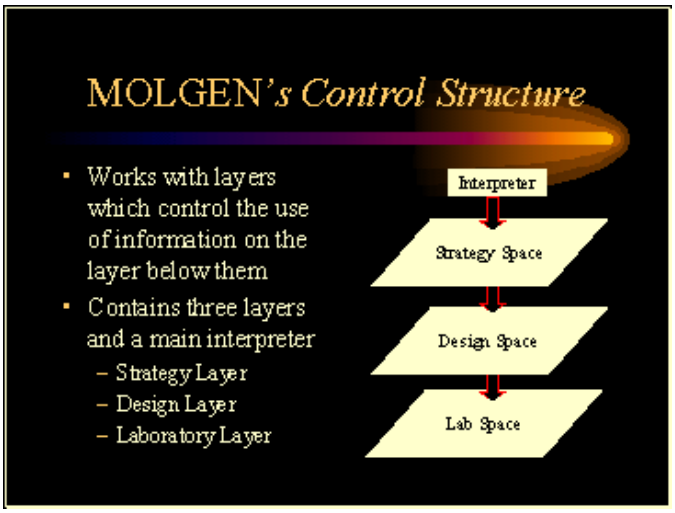
Slide 13


Guessing
When no "safe" refinements can be made the value of a variable must be heuristically guessed
Guessing can lead to backtracking
Backtracking need only be performed on guessed variables (and refinements or definitions based on those variables)
Hopefully, information gained from guessing leads to other "safe" refinements

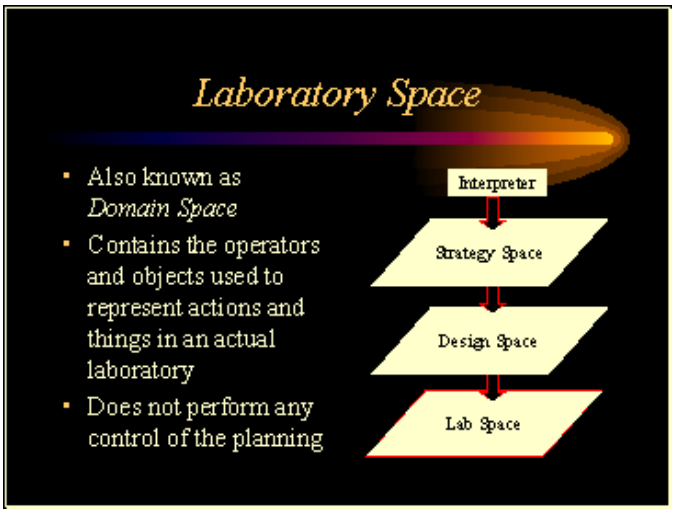
Slide 14


Frame Based Objects
Objects (including operators) in MOLGEN are all created from a generic object of its type
These generic objects contain standard information about that object type as well as possibly relationships to more abstract parent objects
Information in specific object instances may change throughout the course of an experiment

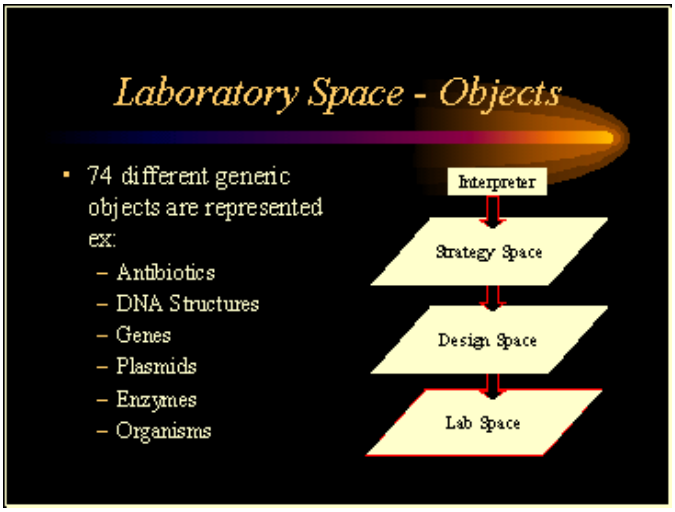
Slide 15


MOLGEN's Control Structure
Works with layers which control the use of information on the layer below them
Contains three layers and a main interpreter
– Strategy Layer
– Design Layer
– Laboratory Layer
Interpreter
Strategy Space
Design Space
Lab Space

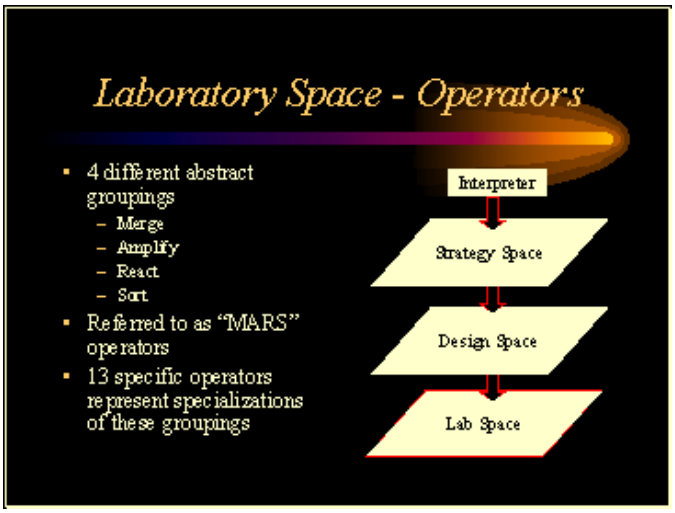
Slide 16


Laboratory Space
Also known as Domain Space
Contains the operators and objects used to represent actions and things in an actual laboratory
Does not perform any control of the planning
Interpreter
Strategy Space
Design Space
Lab Space

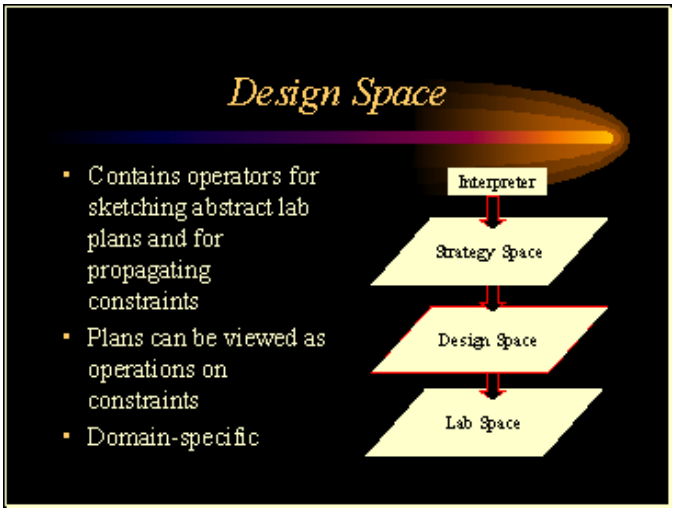
Slide 17


Laboratory Space - Objects
74 different generic objects are represented ex:
– Antibiotics
– DNA Structures
– Genes
– Plasmids
– Enzymes
– Organisms
Interpreter
Strategy Space
Design Space
Lab Space

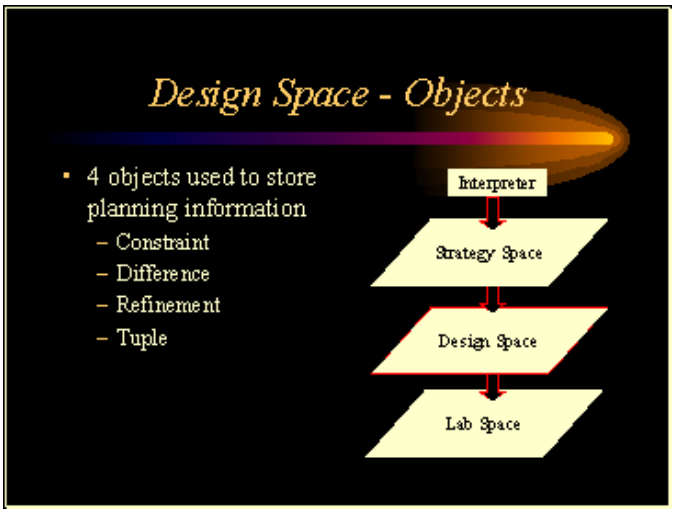
Slide 18


Laboratory Space - Operators
4 different abstract groupings
Merge
Amplify
React
Sort
Referred to as "MARS" operators
13 specific operators represent specializations of these groupings
Interpreter
Strategy Space
Design Space
Lab Space

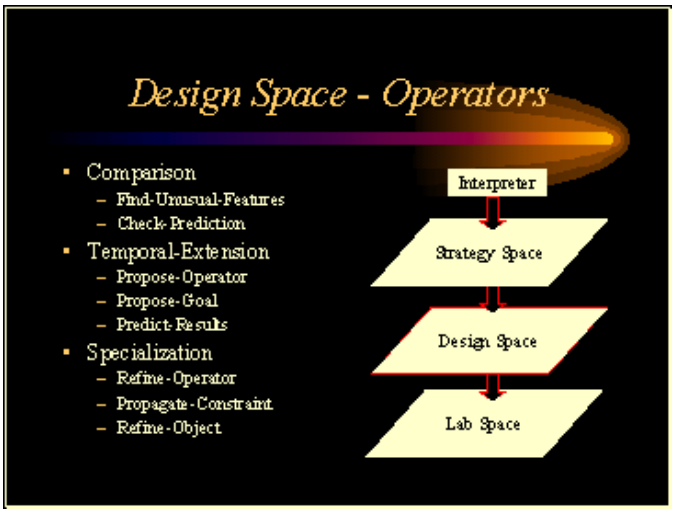
Slide 19


Design Space
Contains operators for sketching abstract lab plans and for propagating constraints
Plans can be viewed as operations on constraints
Domain-specific
Interpreter
Strategy Space
Design Space
Lab Space

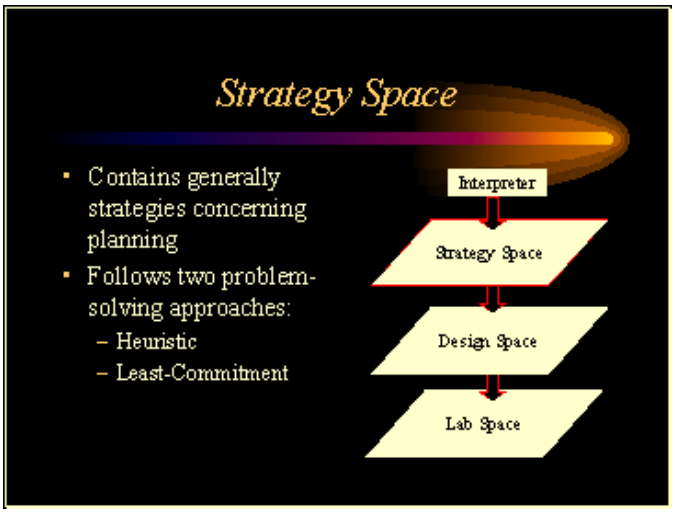
Slide 20


Design Space - Objects
4 objects used to store planning information
– Constraint
– Difference
– Refinement
– Tuple
Interpreter
Strategy Space
Design Space
Lab Space

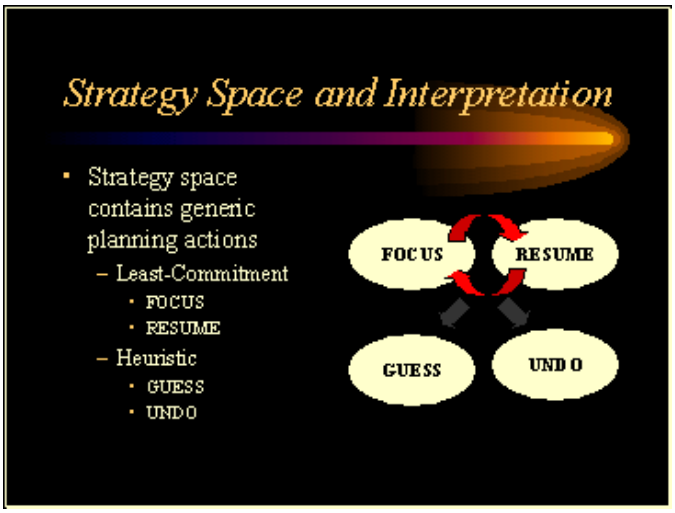
Slide 21


Design Space - Operators
Comparison
Find-Unusual-Features
Check-Prediction
Temporal-Extension
Propose-Operator
Propose-Goal
Predict-Results
Specialization
Refine-Operator
Propagate-Constraint
Refine-Object
Interpreter
Strategy Space
Design Space
Lab Space

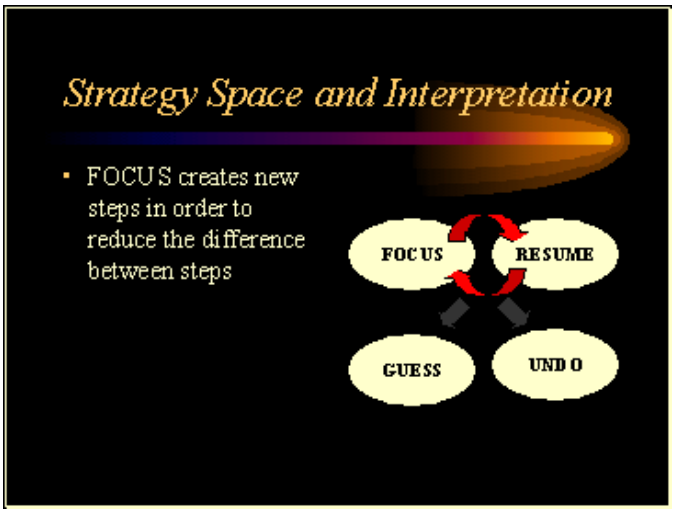
Slide 22


Strategy Space
Contains generally strategies concerning planning
Follows two problem-solving approaches:
– Heuristic
– Least-Commitment
Interpreter
Strategy Space
Design Space
Lab Space

Slide 23


Strategy Space and Interpretation
Strategy space contains generic planning actions
– Least-Commitment
FOCUS
RESUME
– Heuristic
GUESS
UNDO
FOCUS
RESUME
GUESS
UNDO

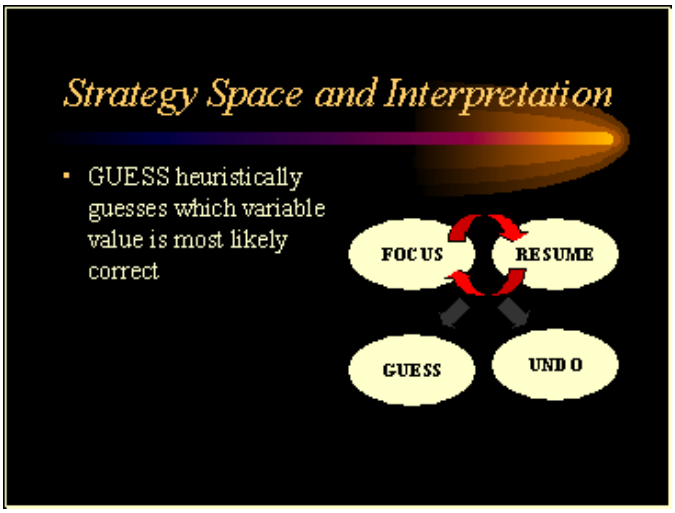
Slide 24


Strategy Space and Interpretation
FOCUS creates new steps in order to reduce the difference between steps
FOCUS
RESUME
GUESS
UNDO

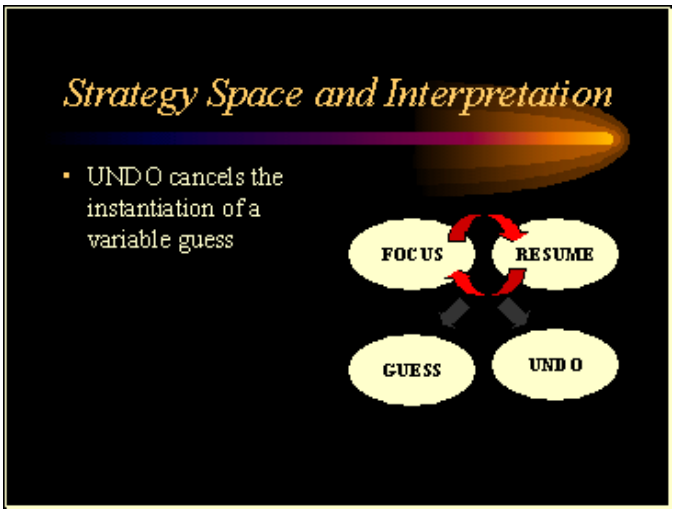
Slide 25

Strategy Space and Interpretation
RESUME attempts to resume suspended steps that may now be able to progress
FOCUS
RESUME
GUESS
UNDO

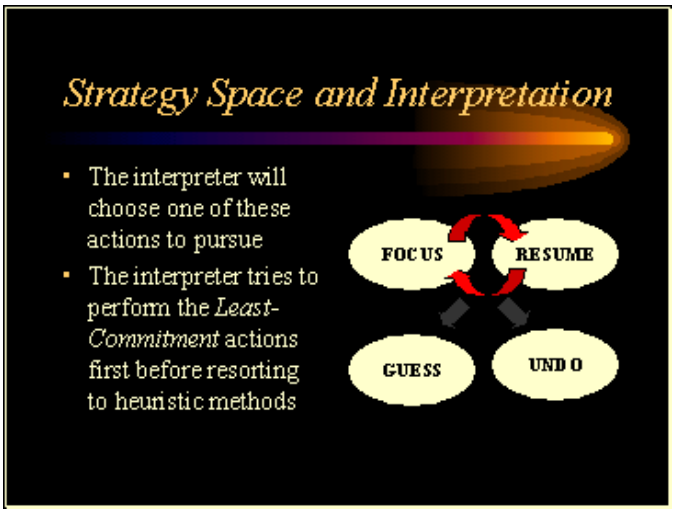
Slide 26


Strategy Space and Interpretation
GUESS heuristically guesses which variable value is most likely correct
FOCUS
RESUME
GUESS
UNDO

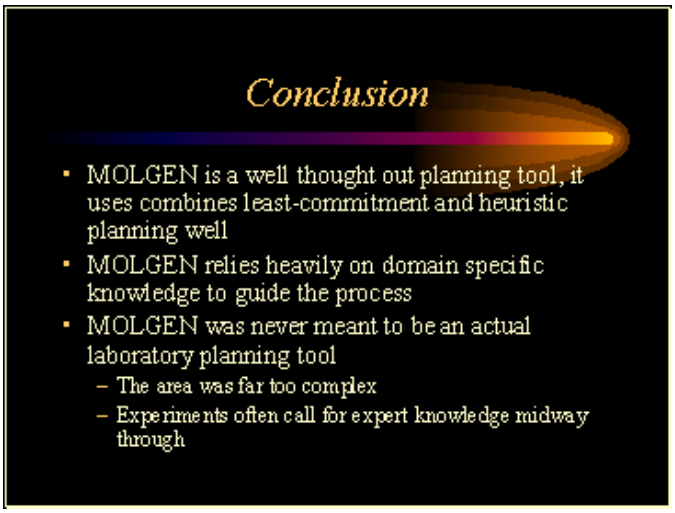
Slide 27


Strategy Space and Interpretation
UNDO cancels the instantiation of a variable guess
FOCUS
RESUME
GUESS
UNDO

Slide 28


Strategy Space and Interpretation
The interpreter will choose one of these actions to pursue
The interpreter tries to perform the Least-Commitment actions first before resorting to heuristic methods
FOCUS
RESUME
GUESS
UNDO

Slide 29


Conclusion
MOLGEN is a well thought out planning tool, it uses combines least-commitment and heuristic planning well
MOLGEN relies heavily on domain specific knowledge to guide the process
MOLGEN was never meant to be an actual laboratory planning tool
The area was far too complex
Experiments often call for expert knowledge midway through