Forest Fires

New Mexico
Supercomputing challenge
Final report
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#87
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Wild fires ruin thousands of square acres of wilderness every year. Wilderness zones are areas defined as completely uninhabited woodland and grass land with an abundance of wildlife. Wild fires differ from forest fires in that forest fires have been contained and are no longer spreading. Containing a wild fire quickly is imperative in reducing damages. To quickly contain a wild fire one must first know how it will grow and spread; to effectively model how a wild fire will grow and spread one must include a minimum of three important variables: wind speed, wind direction, and humidity.

By including wind speed, wind direction, and humidity we can effectively model a basic forest fire. Starlogo limits how complex our program can be, by being unable to model forest density and slope it decreases the level of realism in our model. Slope and forest density are not one-hundred percent necessary to make an effective model, however, the more variables included in a model the more realistic your model will be. Realism is key in a forest fire specific simulation because if you do not allow for enough variables your model may not generate accurate data, and the program is effectively useless at predicting how a fire will grow and burn, and at what rate this will occur. We experienced other fundamental problems when working with Starlogo the most time consuming problem that occurred was a coding error involving how the turtles stack. A stacking error is when multiple turtles are on the same space, this is not always a problem in fact stacking is a normal function of Starlogo. Since stacking is a normal function of Starlogo our error occurred when we tried to code our project so that our turtles wouldn't stack. Fixing this error was imperative because if our turtles don't stack effectively they won't spread correctly therefore compromising how our fire spreads. To correct this problem we sent our program to Miss Lee, after consulting with Miss Lee our stacking error fix through a simple matter of looping our code. To loop coding you have to write a program to call a separate program, this may sound complex however in retrospect it was a relatively simple problem to fix. Fixing our wind direction and stacking were our only coding errors.

After our three variables were working properly, we were able to compare our generated data with the actual tables and charts we lifted our data from. After our data accurately modeled the graphs that forestry rangers carry with them in the field. An overall time crunch prevented us from running our simulation against a real wild fire to see if our program can not only get accurate lab data but also accurate field data. Accurate field and lab data would prove our project a success. Although both are not imperative to our simulations credibility, however, it does look good if you have both.

Forest fire are not always bad, if fires are put out fast enough the burnt lumber is in good enough quality to still be logged. The ability to turn a natural disaster into something productive is a huge accomplishment credited to the district national forestry. Logging can be extremely profitable and is an excellent way of salvaging the brunt wood. Forest fire specific simulations help in understanding how a fire will burn and grow, understanding this is step number one in putting out a fire quickly and safely. A program without enough variables may not generate accurate enough data and is effectively useless. The more variables your model includes the more reliable data it will generate. Three variables is what I would call the bear minimum, humidity is the most area specific and is extremely important in a simulation. Wind likely has the biggest impact on how fires grow and spread and is another must; however to effectively model wind you need to include wind speed and wind direction. Other variables you might want to include are: slope, forest destiny, tree type, rain delay etc.

I would like to accredit three people with helping us with our program: first would be Harold Vicks a programmer who actually writes programs to model forest fires, he gave us books and binders with graphs and charts of data the told how forest fires react under certain conditions. Second is Miss Lee who took time out of her day to help us fix our stacking error. Thirdly there is Miss Penevolpe who managed to yell at Dustyn so much that he at least managed to do about one tenth of the work.

Appendixes

#1

Turtle Procedures:

```
turtles-own [catching]

to fill

setxy random screen-height random screen-width
        if pc = black
                [
                fill
                ]
end

to move
burn
blow
;border
end

to burn
if breed = fire
        [
      set catching random 500
        if catching < 2
                [
                if (count-fire-towards 0 1) < 1   [hatch [setbreed fire setshape shape-12
seth 0 fd 1]]
                if (count-fire-towards 45 1) < 1  [hatch [setbreed fire setshape shape-12
seth 45 fd 1]]
                if (count-fire-towards 90 1) < 1  [hatch [setbreed fire setshape shape-12
seth 90 fd 1]]
                if (count-fire-towards 135 1) < 1 [hatch [setbreed fire setshape shape-12
seth 135 fd 1]]
                if (count-fire-towards 180 1) < 1 [hatch [setbreed fire setshape shape-12
seth 180 fd 1]]
                if (count-fire-towards 225 1) < 1 [hatch [setbreed fire setshape shape-12
seth 225 fd 1]]
                if (count-fire-towards 270 1) < 1 [hatch [setbreed fire setshape shape-12
seth 270 fd 1]]
                ]
```

```
        if pc = 52 or pc = 54
                [
                stamp brown
                ]
        ]
end

to rain
if breed = fire
        [
        die
        ]
end

to blow
if breed = fire
[
seth numd
if nums >= 13 [seth pick [-14 -12 -10 -8 -6 -4 -2 0 +2 +4 +6 +8 +10 +12 +14]]
if nums >= 7 and nums <= 12 [seth pick [-34 -32 -30 -28 -24
-20 -16 -12 -8 -4 0 +4 +8 +12 +16 +20 +24 +28 +30 +32 +34]]

if nums <= 6 [seth pick [-50 -56 -44 -40 -36 -32 -28 -24 -20 -16 -12 -8 -4 0 +4 +8 +12
+16 +20 +24 +28 +32 +36 +40 +44 +46 +50]]
]


end

;to border
;if xcor = 39 [ask-turtle [die]]
;if xcor = -39 [ask-turtle [die]]
;if ycor = 37 [ask-turtle [die]]
;if ycor = -37 [ask-turtle [die]]
;end
```

#**2**

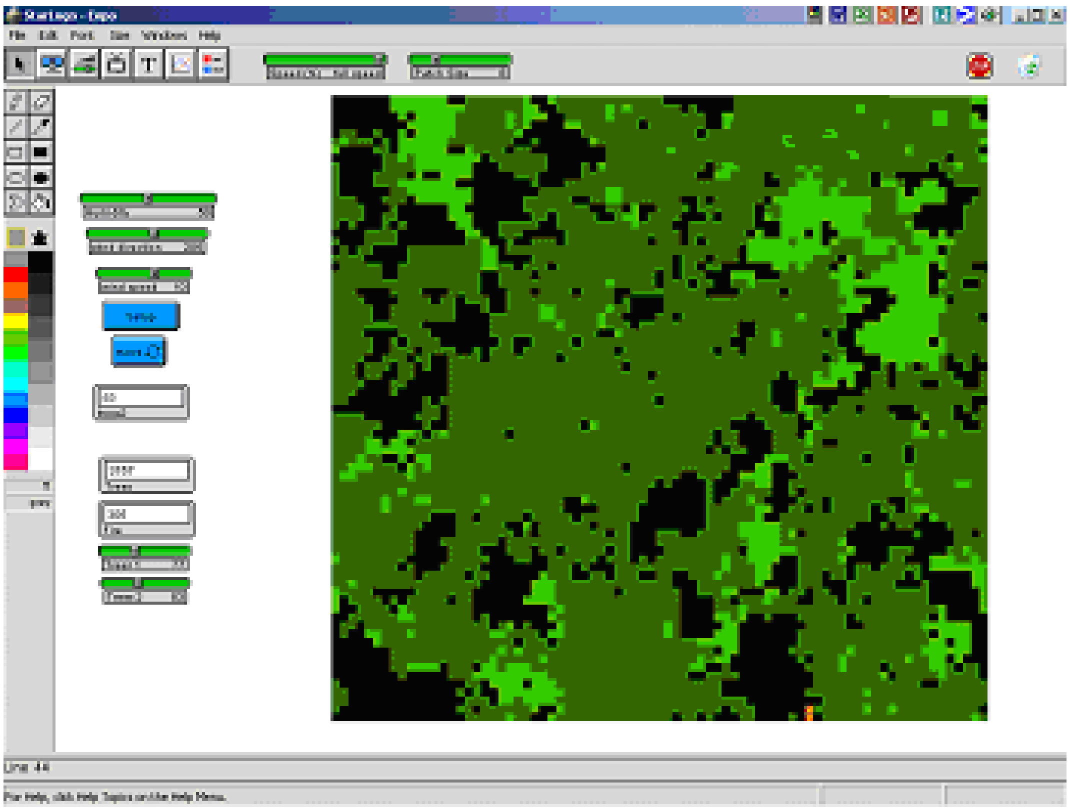
Observer Procedure:

```
breeds [fire trees trees1]
globals [humidity highest_number fire_count]
patches-own [bkgd1]


to setup
ct
	; these make my Trees spawn by itself
	create-trees-and-do 1 [setshape square-shape]
	repeat 20
	[ask-turtles
		[setxy (random screen-width) (random screen-height)
		setc 54
		repeat (numg * 4)
			[stamp color seth random 360 fd 1]
		]

	]
	create-trees1-and-do 1 [setshape shape-13]
	repeat 20
	[ask-turtles
		[setxy (random screen-width) (random screen-height)
		setc 52
		repeat (numt * 4)
			[stamp color seth random 360 fd 1]
		]
]

create-fire-and-do 1 [setshape shape-12]

ask-turtles [fill]

end
```

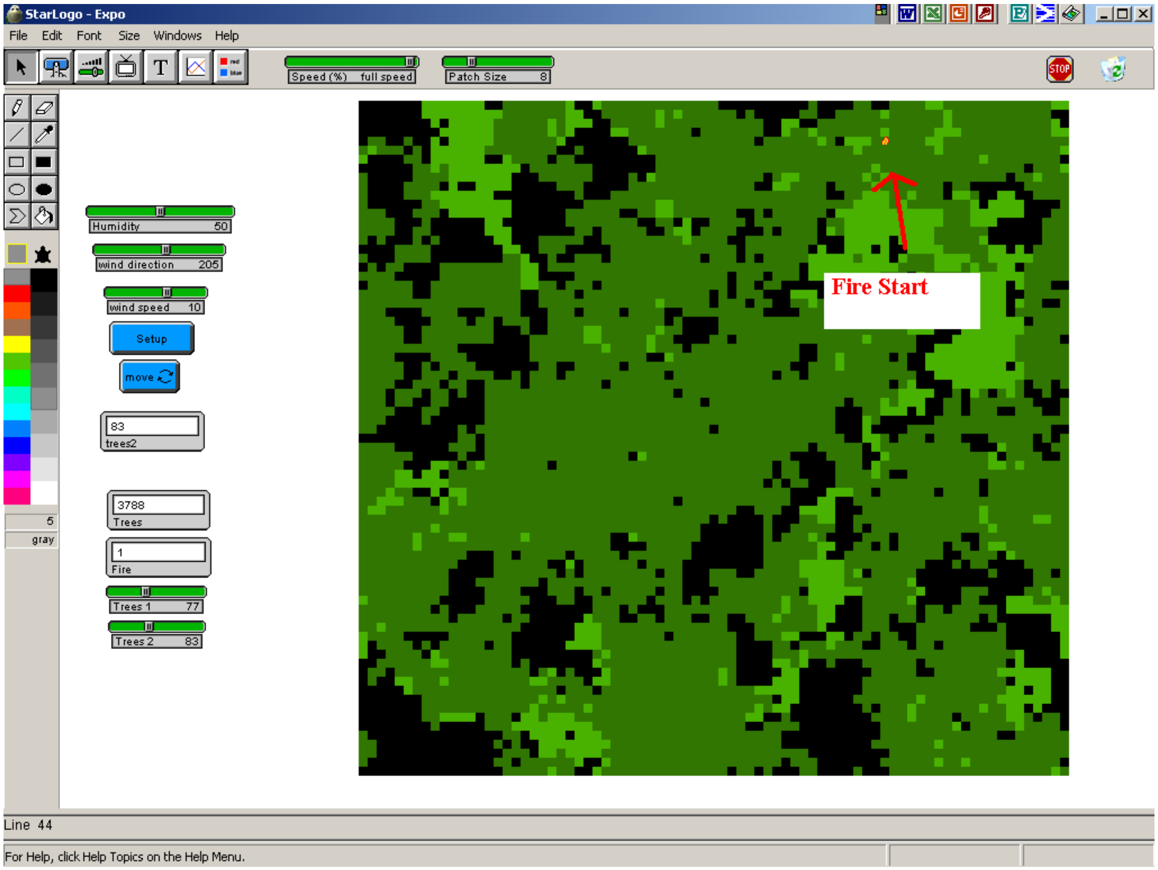
#3

Screen 1

This is what our setup program looks like when you start it. It generates the trees by itself according to the tree slider

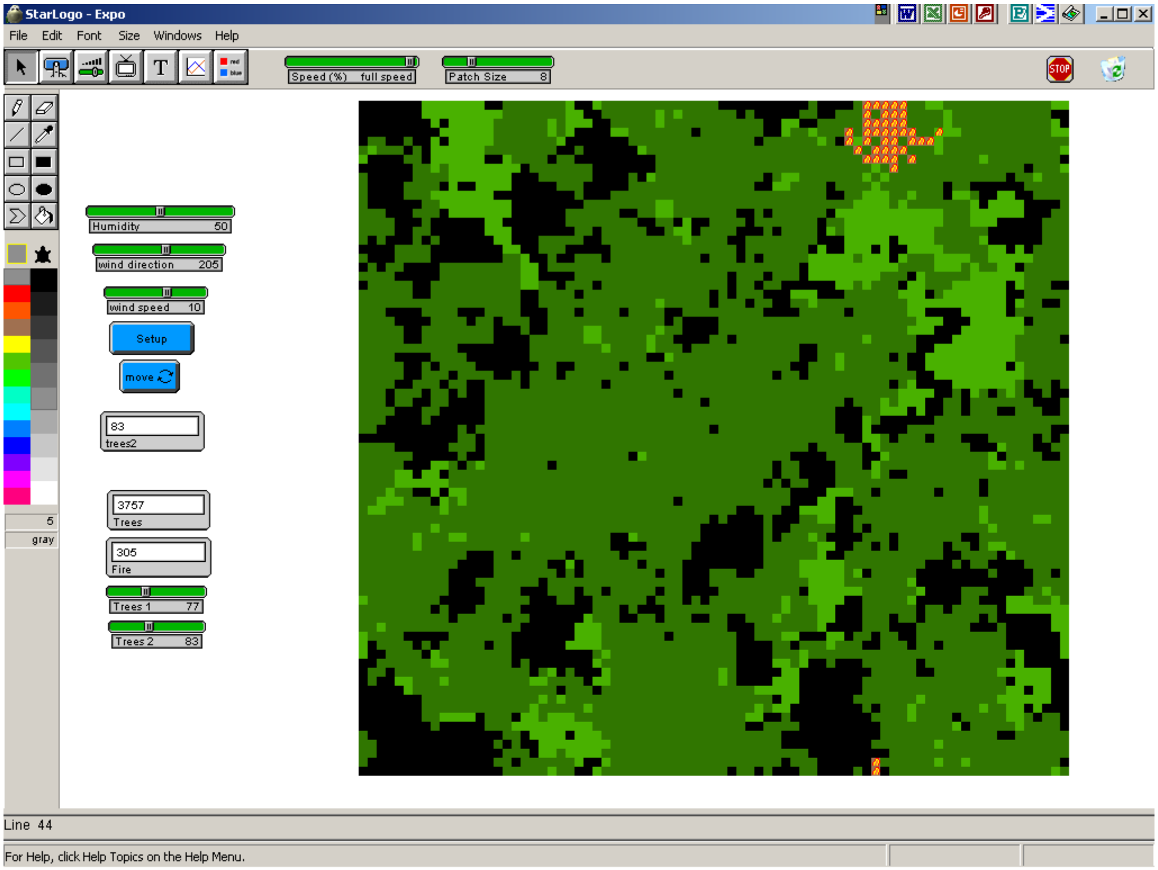


Screen 2



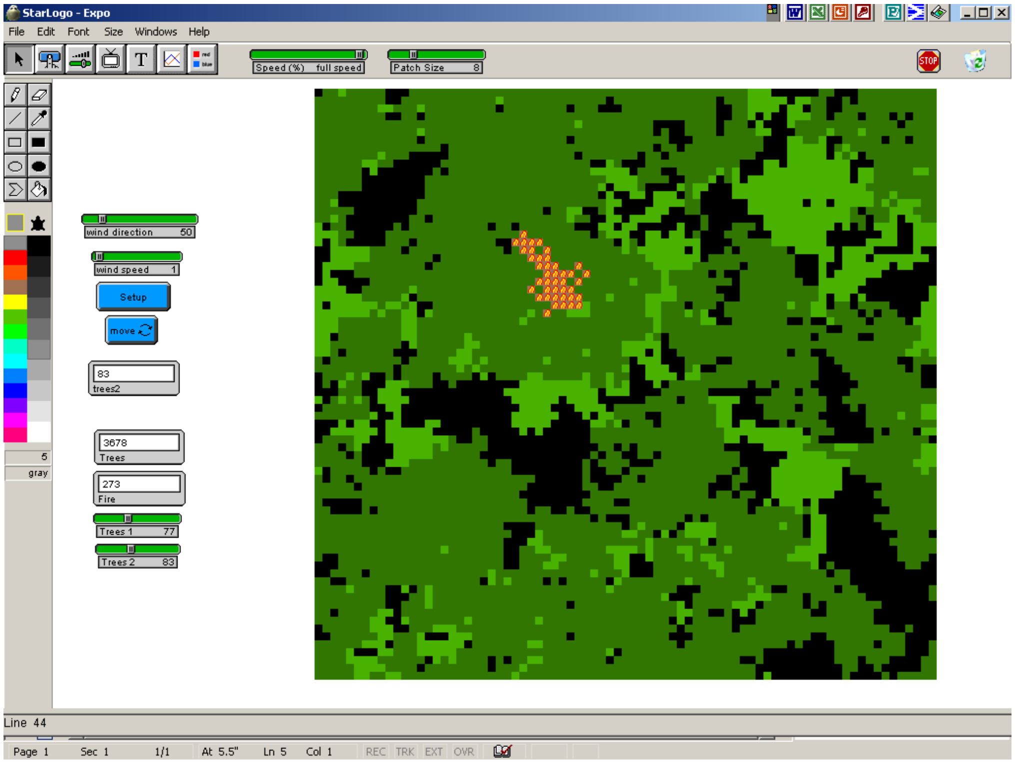
This shows that our fire randomly generates.

Screen 3



This fire spread shows fire growing under the conditions of little wind speed and high humidity.

Screen 4



This fire moves with little wind speed and a higher wind direction

#4

Humidity Tabel

Relative Humidity (Percent)

Dry Bulb Temp (F)	0-4	5->9	10 -> 14	15-19	20-24	25-29	30-34
ten - 29	1	2	2	3	4	5	5
30-49	1	2	2	3	4	5	5
50-69	1	2	2	3	4	5	5
70-89	1	1	2	2	3	4	5
90-109	1	1	2	2	3	4	4
109+	1	1	2	2	3	4	4

Relative Humidity (Percent)

Dry Bulb Temp (F)	35-39	40-44	45-49	50-54	55-59	60-64	65-69
ten - 30	6	7	8	8	8	9	9
30-50	6	7	7	7	8	9	9
50-70	6	6	7	7	8	8	9
70-90	5	6	7	7	8	8	8
90-110	5	6	7	7	8	8	8
109+	5	6	7	7	8	8	8

Relative Humidity (Percent)

Dry Bulb Temp (F)	70-74	75-79	80-84	85-89	90-94	95-99	100
ten - 31	10	11	12	12	13	13	14
30-51	10	10	11	12	13	13	13
50-71	9	10	11	12	12	12	13
70-91	9	10	10	11	12	12	13
90-111	9	10	10	11	12	12	13
109+	9	10	10	11	12	12	12

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