

## Lecture 18 - Nov. 12

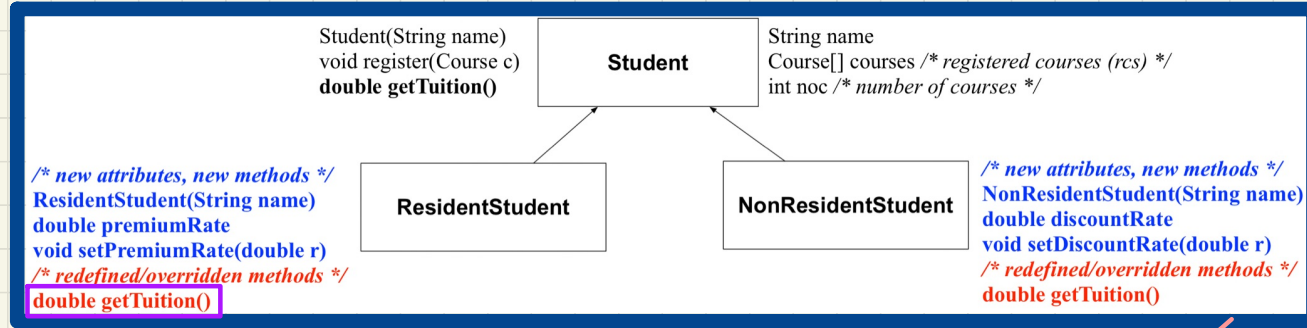
### Inheritance

***Dynamic Binding: Intuition  
Ancestors vs Descendants, Expectation  
Variable Substitutions***

## Announcements/Reminders

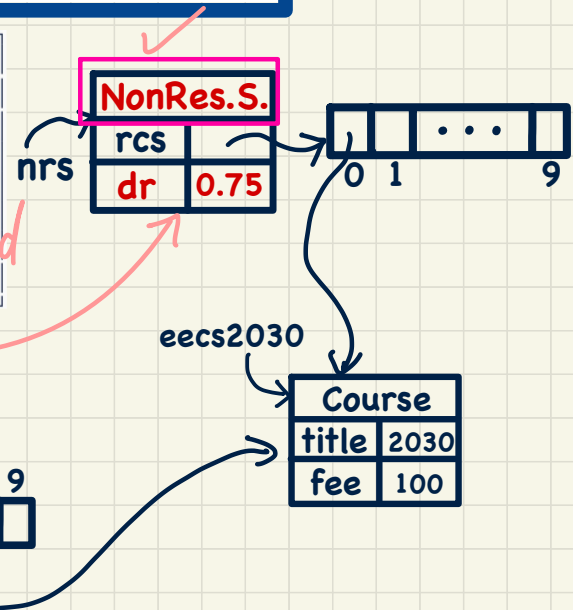
- **WrittenTest2** tomorrow
- **Lab4** due this Friday at noon
- **ProgTest3** next Wednesday, November 20
- **ProgTest2** results & feedback released

# Intuition: Dynamic Binding

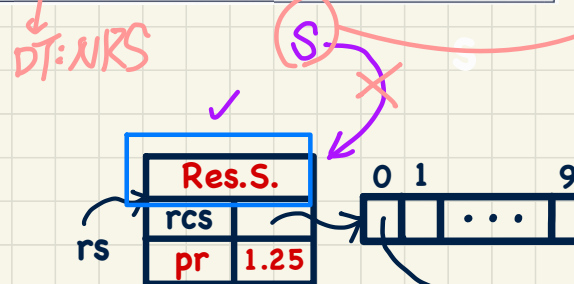


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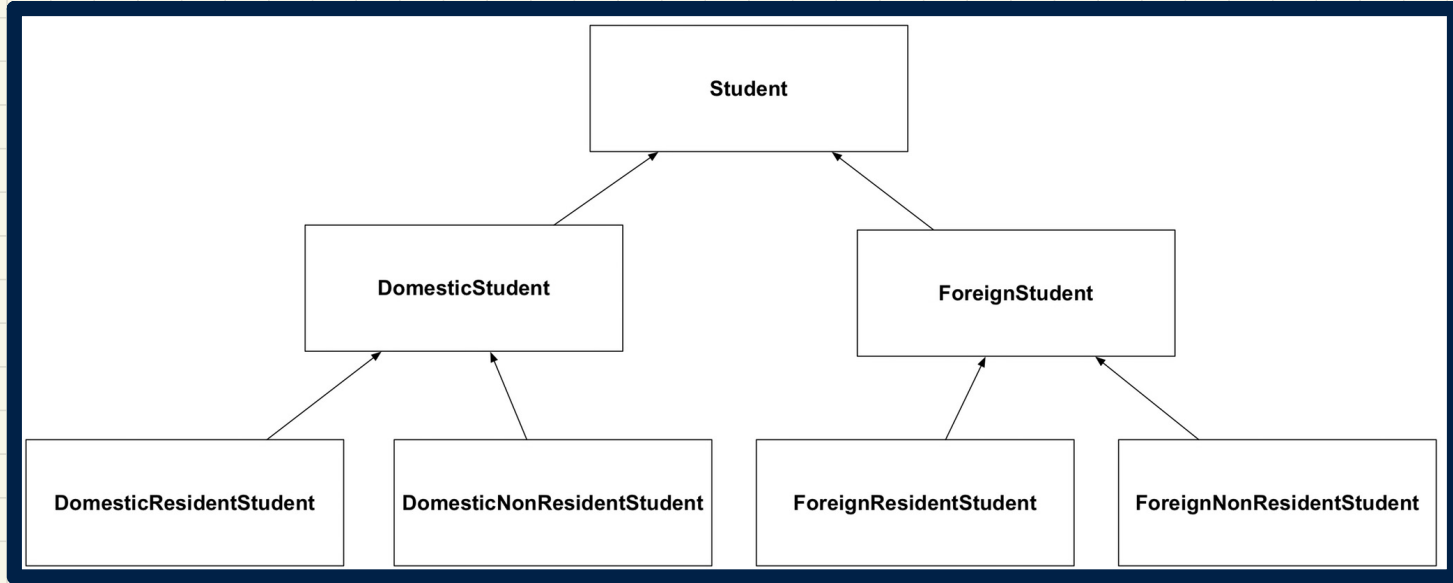
1 Course eeecs2030 = new Course("EECS2030", 100.0);
2 Student s; // ST of S
3 ResidentStudent rs = new ResidentStudent("Rachel");
4 NonResidentStudent nrs = new NonResidentStudent("Nancy");
5 rs.setPremiumRate(1.25); rs.register(eeecs2030);
6 nrs.setDiscountRate(0.75); nrs.register(eeecs2030);
7 s = rs; System.out.println(s.getTuition()); // RS version called
8 s = nrs; System.out.println(s.getTuition()); // NRS version called
  
```



Before ①	ST of S	DT of S
After ①	Student	RS
Before ②		RS
After ②		NRS



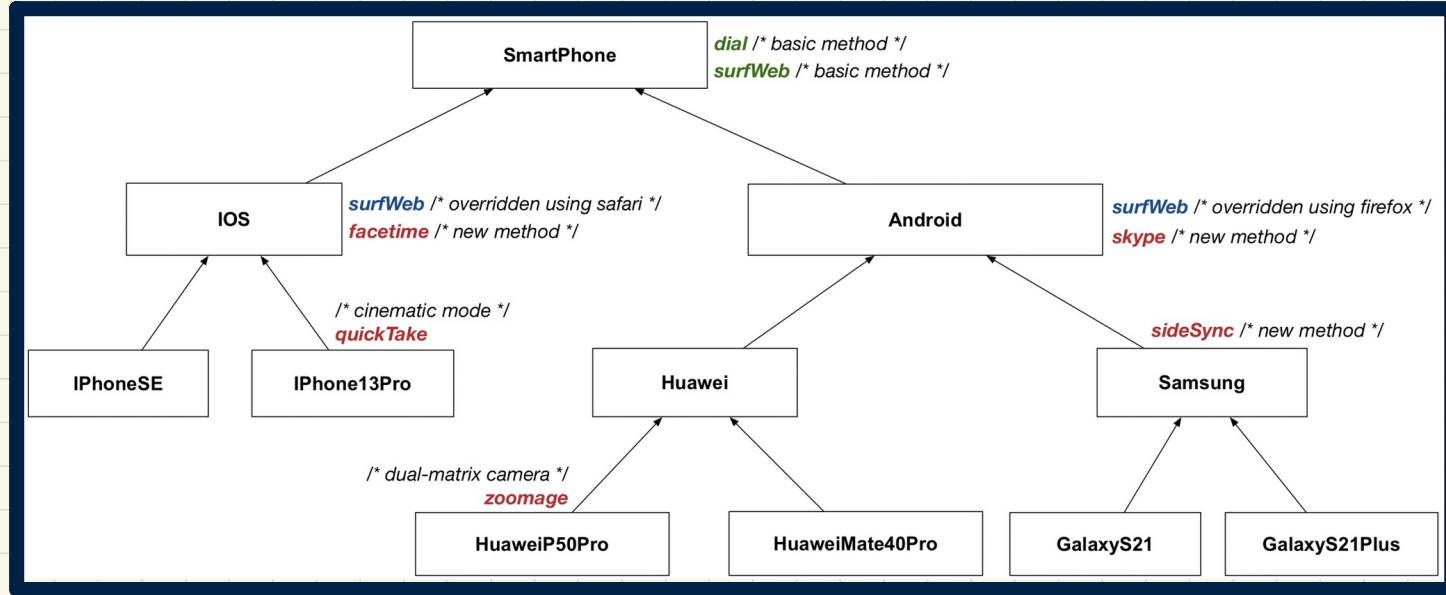
# Multi-Level Inheritance Hierarchy: Students



## Reflections: *int kind* ⑦

- For Design 1, how many encodings to check for each method?
- For Design 2, how many arrays to store for SMS? ⑦
- For Design 3, where are common attributes/methods stored?

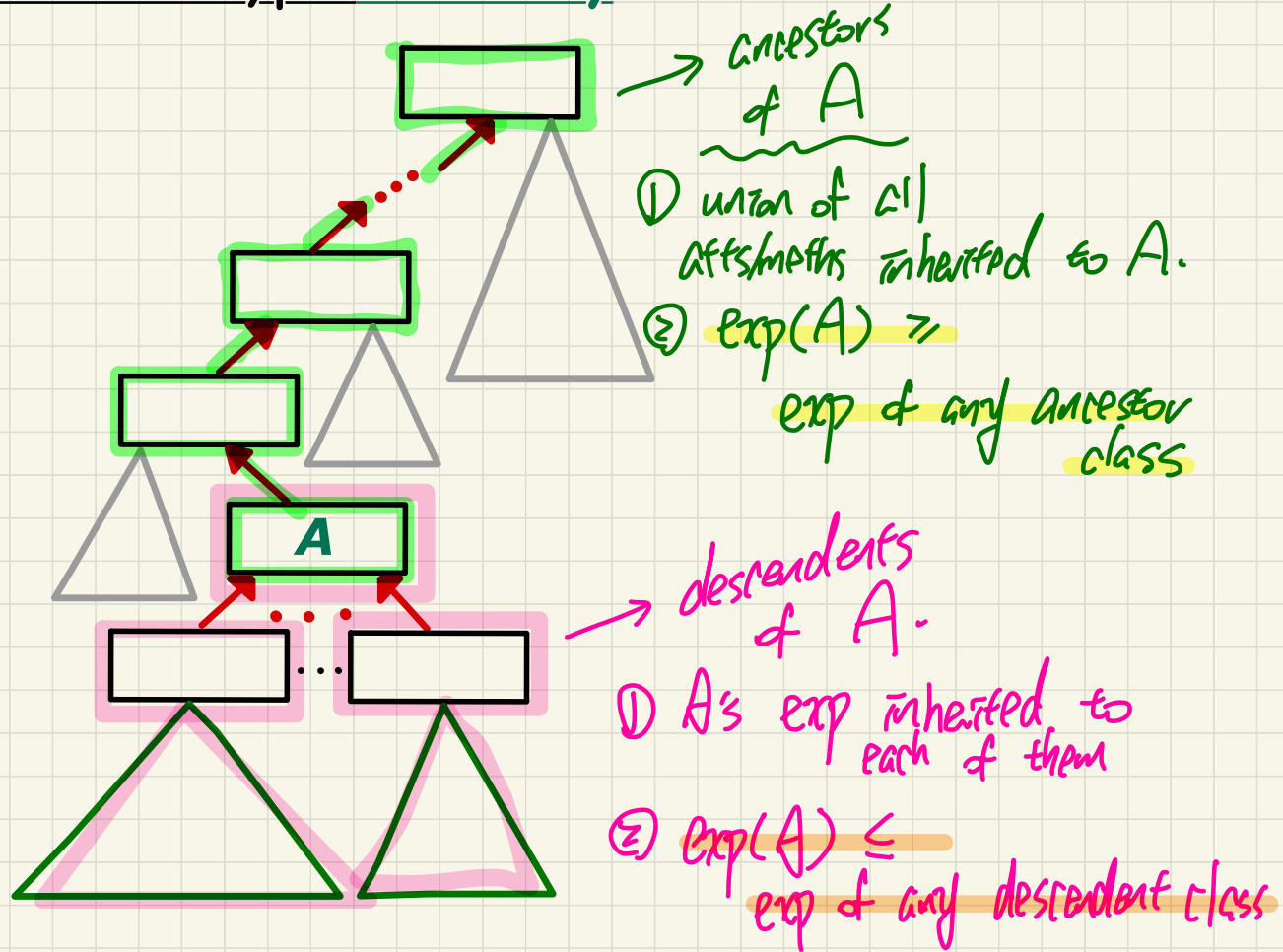
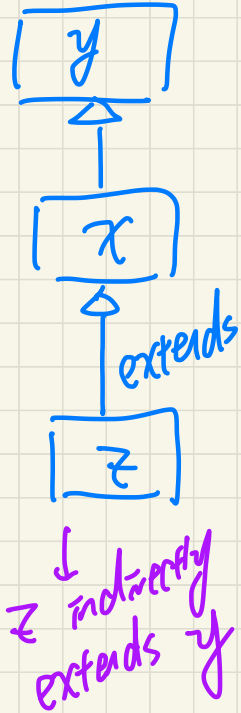
# Multi-Level Inheritance Hierarchy: Smartphones



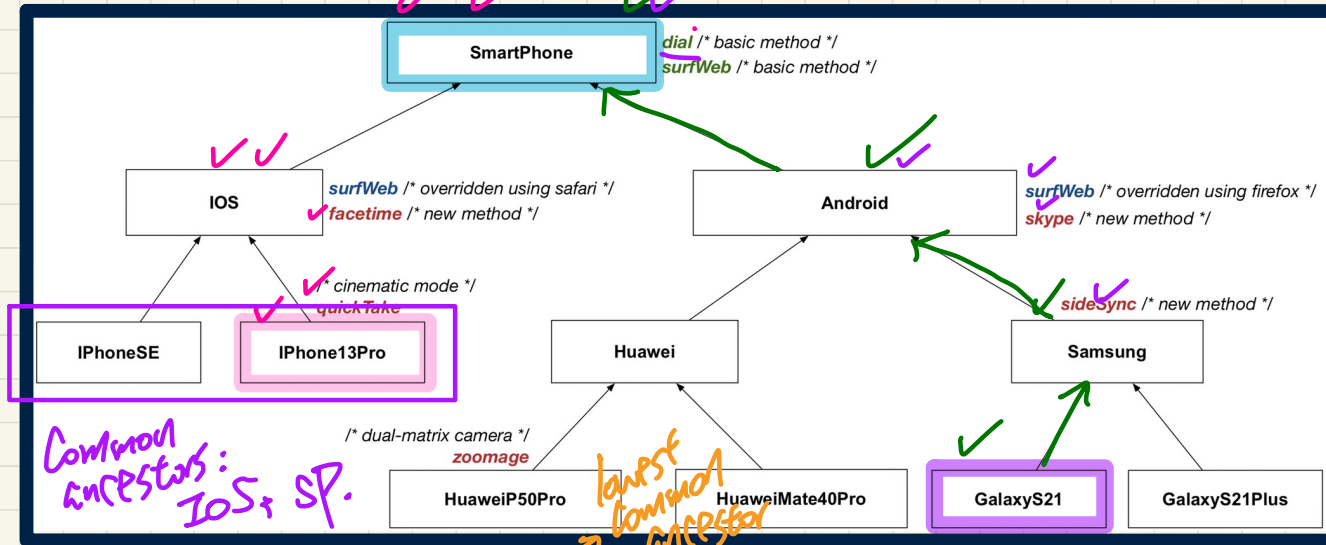
## Reflections:

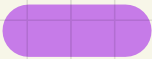
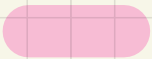
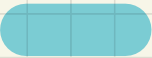
- For Design 1, how many encodings to check for each method?
- For Design 2, how many arrays to store for SMS?
- For Design 3, where are common attributes/methods stored?

# Inheritance Forms a Type Hierarchy



# Inheritance Accumulates Code for Reuse



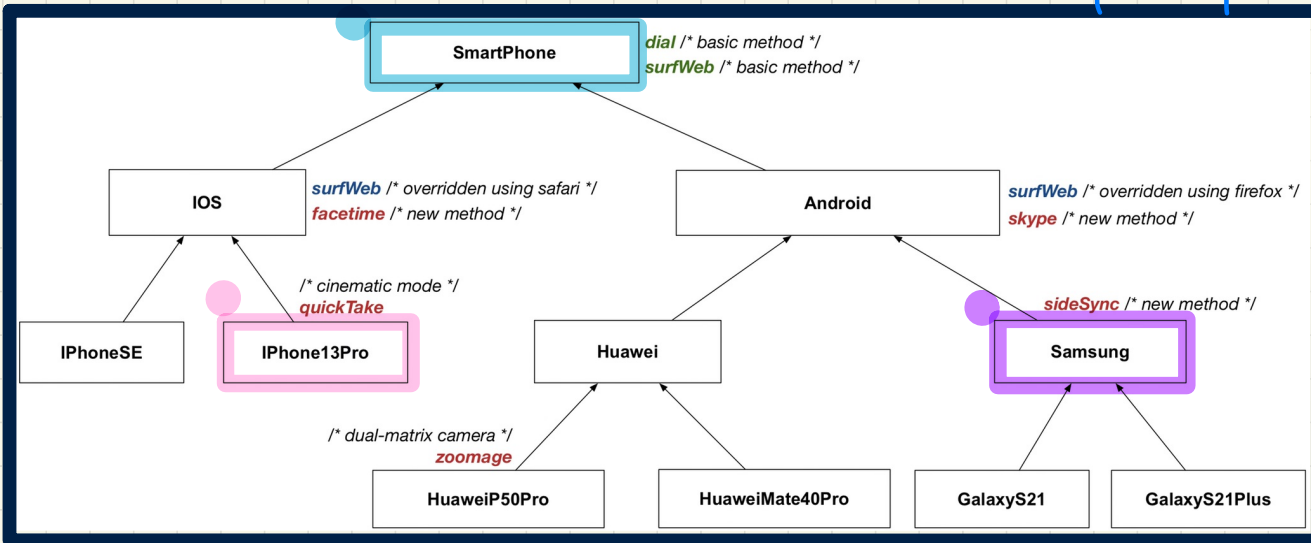
	ancestors	expectations	descendants
	GS21, SS, An, SP	sidesync, skype, surfWeb, dial	GS21
	IP13Pro, IOS, SP	quickTake, facetime, dial, surfWeb	IP13Pro
	SP	dial, surfWeb	all classes

Handwritten note: "inherited exp from common ancestor" with an arrow pointing from the 'all classes' cell to the 'expectations' column.

# Inheritance Accumulates Code for Reuse

①  $sp1 \doteq sp2 ;$   
 $sp1 = sp3 ;$

to be valid the exp of  $sp1$ 's ST must be satisfied  
 $\Rightarrow$   
 $sp2$  and  $sp3$  give both accep  
 'their STs are descendants



②  $sp2 \neq sp1 ;$   $sp2 \neq sp3 ;$

**SmartPhone**  $sp1 ;$   
**iPhone13Pro**  $sp2 ;$   
**Samsung**  $sp3 ;$

$sp1 = ? ;$   
 $sp2 = ? ;$   
 $sp3 = ? ;$

in order for the var. assignments to be compatible = what types of variables can appear at the RST?



Complets?

$$\boxed{\text{var } I} \quad = \quad \boxed{\text{var } Z} \quad \bar{=}$$

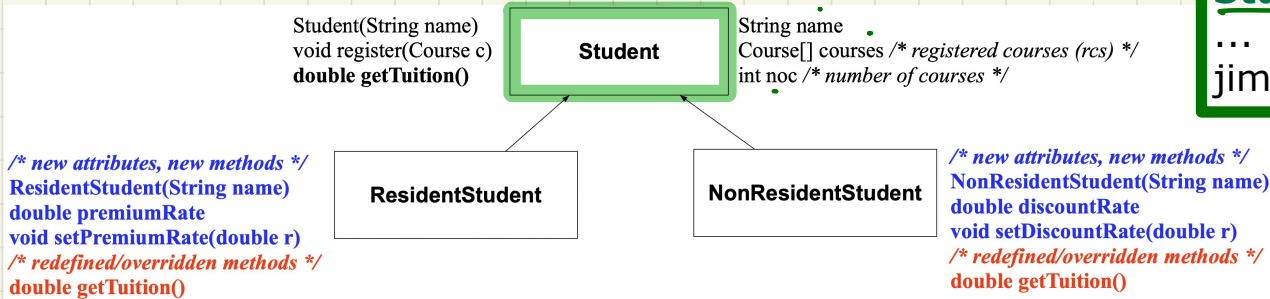
$ST: T_1$ 
 $ST: \underline{T_2}$

Complets if:

- ①  $T_2$  can satisfy the expectation of  $T_1$
- ②  $T_2$  is a descendent class of  $T_1$

# Static Types determine Expectations

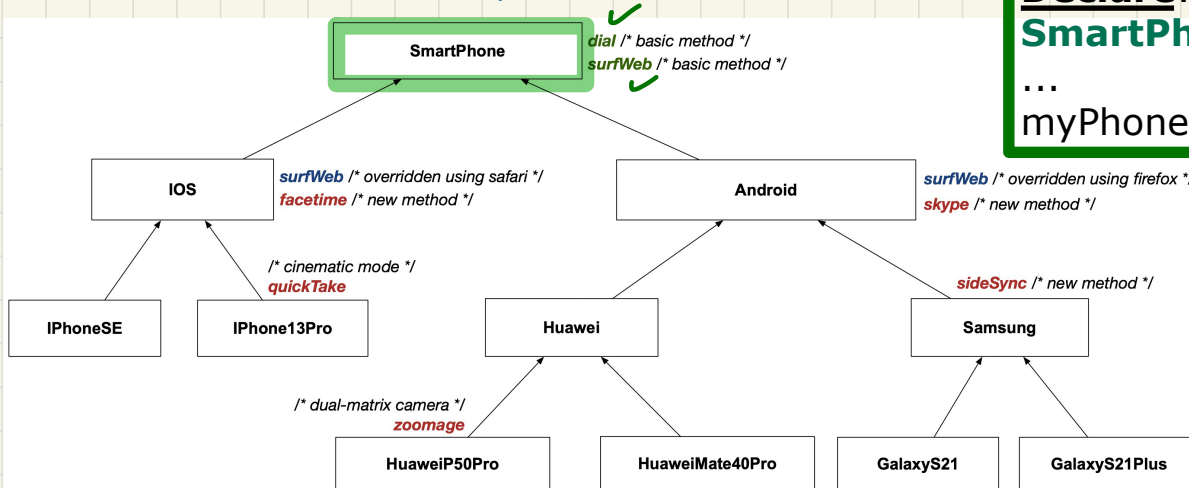
## Inheritance Hierarchy: Students



**Declare:**  
Student jim;  
...  
jim.??

all attr/methods  
in Student

## Inheritance Hierarchy: Smart Phones



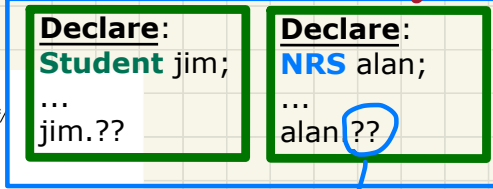
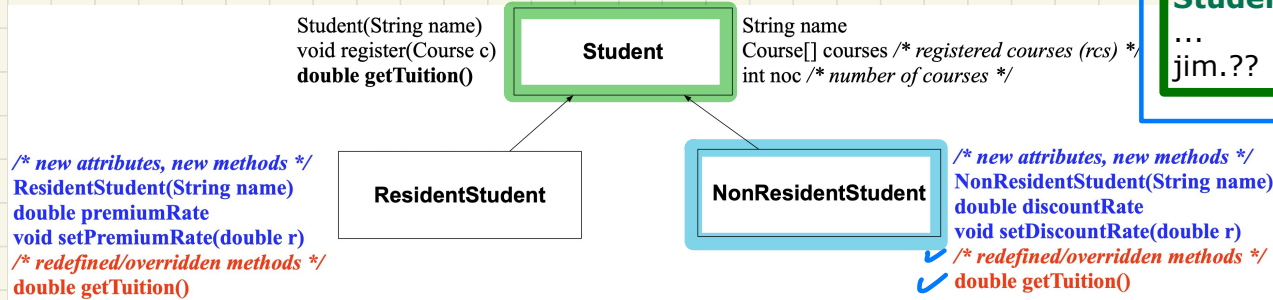
**Declare:**  
SmartPhone myPhone;  
...  
myPhone.??

all attr/methods  
in SP.

# Static Types determine Expectations

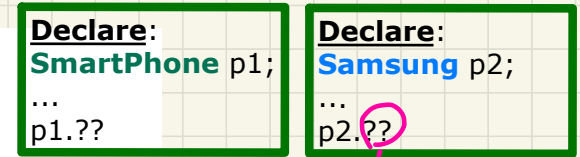
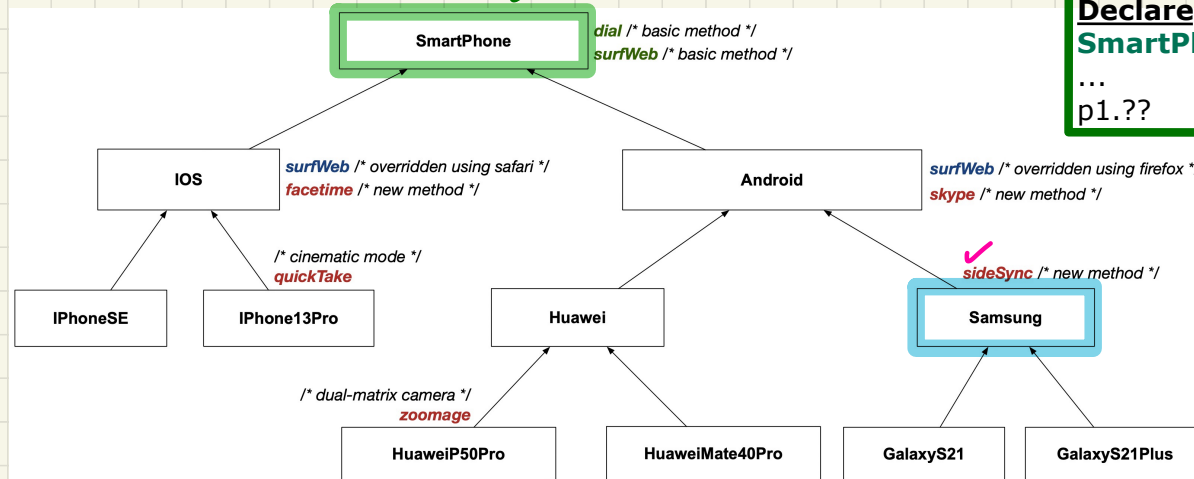
*Jim = al/cn s  
Jim.setDr(. ->) ; ∴ ST of Jim  
remains Student*

## Inheritance Hierarchy: Students



*① all attributes  
in Student  
② dr, setDr.*

## Inheritance Hierarchy: Smart Phones



*stateSync  
skype  
surfWeb  
dial  
inherited from  
SP class.*

$v_1$  is substituted by  $v_2$

$$v_1 \equiv v_2 \Rightarrow$$

$v_1.x$

