



DEPARTAMENTO  
DE COMPUTACION

Facultad de Ciencias Exactas y Naturales - UBA

# Trabajo Práctico Especificación

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Integrante	LU	Correo electrónico
Garay, Iván Alejandro	60/16	ivangaray101@gmail.com
Ponce, Ezequiel	730/21	ezequielponcepe11gmail.com
Bottaro, Leonel	606/21	leo.bottaro98@gmail.com



## Facultad de Ciencias Exactas y Naturales

Universidad de Buenos Aires

Ciudad Universitaria - (Pabellón I/Planta Baja)

Intendente Güiraldes 2610 - C1428EGA

Ciudad Autónoma de Buenos Aires - Rep. Argentina

Tel/Fax: (++54 +11) 4576-3300

<http://www.exactas.uba.ar>

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# 1. Ejercicio 1

```
proc esEncuestaVálida (in th :  $eph_h$ , in ti :  $eph_i$ , out result :  $Bool$ ) {  
  Pre { $True$ }  
  Post { $result = True \iff encuestaVálida(th, ti)$ }  
}
```

## 1.1. Predicados y Auxiliares generales

```
pred encuestaVálida (in th :  $eph_h$ , in ti :  $eph_i$ ) {  
  esMatriz(th)  $\wedge$  esMatriz(ti)  $\wedge$   
  hayElementos(th)  $\wedge$  hayElementos(ti)  $\wedge$   
  longitud(th, 12)  $\wedge$  longitud(ti, 11)  $\wedge$   
  hogarSiiIndividuo(th, ti)  $\wedge$   
  sinRepetidosHogares(th)  $\wedge$  sinRepetidosIndividuos(ti)  $\wedge$   
  LongitudYLatitud(th)  $\wedge$   
  AñoYTrimetreIguales(th, ti)  $\wedge$   
  cantidadMiembros(th, ti)  $\wedge$   
  compararHabitaciones(th)  $\wedge$   
  atributosCategoricosHogar(th)  $\wedge$  atributosCategoricosIndividuos(ti)  
}  
pred esMatriz (in M :  $seq\langle seq\langle \mathbb{Z} \rangle \rangle$ ) {  
  ( $\forall i : \text{in } \mathbb{Z}$ ) ( $0 \leq i < |M| \longrightarrow_L$   
     $|M[i]| > 0 \wedge$   
    ( $\forall j : \text{in } \mathbb{Z}$ ) ( $0 \leq j < |M| \longrightarrow_L |M[i]| = |M[j]|$ ))  
}  
pred hayElementos (in M :  $seq\langle seq\langle \mathbb{Z} \rangle \rangle$ ) {  
  ( $\exists i : \text{in } \mathbb{Z}$ ) ( $0 \leq i < |M| \wedge_L |M[i]| > 0$ )  
}  
pred longitud (in M :  $seq\langle seq\langle \mathbb{Z} \rangle \rangle$ , in n :  $\mathbb{Z}$ ) {  
  ( $\forall i : \text{in } \mathbb{Z}$ ) ( $0 \leq i < |M| \longrightarrow_L |M[i]| = n$ )  
}  
pred  $\in$  (in m :  $seq\langle \mathbb{Z} \rangle$ , in M :  $seq\langle seq\langle \mathbb{Z} \rangle \rangle$ ) {  
  ( $\exists i : \mathbb{Z}$ ) ( $0 \leq i < |M| \wedge_L M[i] = m$ )  
}  
pred hogarSiiIndividuo (in th :  $eph_h$ , in ti :  $eph_i$ ) {  
  ( $\forall hogar : seq\langle \mathbb{Z} \rangle$ ) ( $hogar \in th \longrightarrow \exists individuo : seq\langle \mathbb{Z} \rangle$ )  
  ( $individuo \in ti \wedge hogar[ord(HOGCODUSU)] = individuo[ord(INDCODUSU)]$ )  $\wedge$   
  ( $\forall individuo : seq\langle \mathbb{Z} \rangle$ ) ( $individuo \in ti \longrightarrow \exists hogar : seq\langle \mathbb{Z} \rangle$ )  
  ( $hogar \in th \wedge hogar[ord(HOGCODUSU)] = individuo[ord(INDCODUSU)]$ )  
}  
pred sinRepetidosHogares (in th :  $eph_h$ ) {  
  ( $\forall hogar1, hogar2 : seq\langle \mathbb{Z} \rangle$ )  
  ( $hogar1, hogar2 \in th \longrightarrow hogar1[ord(HOGCODUSU)] \neq hogar2[ord(HOGCODUSU)]$ )  
}  
pred sinRepetidosIndividuos (in ti :  $eph_i$ ) {  
  ( $\forall individuo1, individuo2 : seq\langle \mathbb{Z} \rangle$ )  
  ( $individuo1, individuo2 \in ti \longrightarrow$   
  ( $individuo2[ord(INDCODUSU)] = individuo2[ord(INDCODUSU)] \longrightarrow$   
  ( $individuo2[ord(COMPONENTE)] \neq individuo2[ord(COMPONENTE)]$ ))  
}  
pred LongitudYLatitud (in th) {  
  ( $\forall hogar : seq\langle \mathbb{Z} \rangle$ ) ( $hogar \in th \longrightarrow hogar[orden(HOGLATITUD)] > 0 \wedge hogar[orden(HOGLONGITUD)] > 0$ )  
}  
pred AñoYTrimetreIguales (in th :  $eph_h$ , in ti :  $eph_i$ ) {  
  ( $\forall hogar1, hogar2, individuo1, individuo2 : seq\langle \mathbb{Z} \rangle$ ) ( $hogar1, hogar2 \in th \wedge individuo1, individuo2 \in ti \longrightarrow$   
  ( $hogar1[ord(HOGAÑO)] = hogar2[ord(HOGAÑO)]$ )  $\wedge$   
  ( $hogar1[ord(HOGTRIMESTRE)] = hogar2[ord(HOGTRIMESTRE)]$ )  $\wedge$ 
```

```

(individuo1[ord(INDAÑO)] = individuo2[ord(INDAÑO)]) ∧
(individuo1[ord(INDTRIMESTRE)] = individuo2[ord(INDTRIMESTRE)]) ∧
(individuo1[ord(INDAÑO)] = hogar1[ord(HOGAÑO)] ∧
(individuo1[ord(INDTRIMESTRE)] = hogar1[ord(HOGTRIMESTRE)])
)
}
pred cantidadMiembros (in th : ephh, in ti : ephi) {
  (∀hogar : seq(ℤ))(hogar ∈ th ⇒ #personasViviendo(hogar, ti) ≤ 20)
}
aux #personasViviendo (in hogar : seq(ℤ), in ti : ephi) : ℤ =
 $\sum_{i=0}^{|ti|-1}$  if hogar[ord(HOGCODUSU)] = ti[i][ord(INDCODUSU)] then 1 else 0 fi;
pred compararHabitaciones (in th : ephh) {
  (∀hogar : seq(ℤ))(hogar ∈ th ⇒ hogar[ord(IV2)] ≥ hogar[ord(II2)])
}
pred atributosCategoricosHogar (in th : ephh) {
  (∀hogar : seq(ℤ))(hogar ∈ th ⇒ 1 ≤ hogar[ord(II7)] ≤ 3 ∧
  1 ≤ hogar[ord(REGION)] ≤ 6 ∧
  0 ≤ hogar[ord(MAS_500)] ≤ 1 ∧
  1 ≤ hogar[ord(IV1)] ≤ 5 ∧
  1 ≤ hogar[ord(II3)] ≤ 2 ∧
  0 ≤ hogar[ord(II2)] ≤ hogar[ord(IV2)])
}
pred atributosCategoricosIndividuos (in ti : ephi) {
  (∀individuo : seq(ℤ))(individuo ∈ ti ⇒ 1 ≤ individuo[ord(CH4)] ≤ 2 ∧
  0 ≤ individuo[ord(NIVEL_ED)] ≤ 1 ∧
  -1 ≤ individuo[ord(ESTADO)] ≤ 1 ∧
  0 ≤ individuo[ord(CAT_OCUP)] ≤ 4 ∧
  1 ≤ individuo[ord(PP04G)] ≤ 10)
}

```

## 2. Ejercicio 2

```

proc histHabitacional (in th :  $eph_h$ , in ti :  $eph_i$ , in region :  $\mathbb{Z}$ , out res :  $seq\langle\mathbb{R}\rangle$ ) {
  Pre { $encuestaVálida(th, ti)$ }
  Post { $esMax(th, region, |res|) \wedge pertenece(th, region, |res|) \wedge ihogaresEnPosicion_i(th, region)$ }
}

```

### 2.1. Predicados y Auxiliares generales

```

pred esMax (in th:  $eph_h$ , in region:  $\mathbb{Z}$ , in n:  $\mathbb{Z}$ ) {
   $(\forall i : \mathbb{Z})(0 \leq i < |th| \wedge_L (th[i][ord(REGION)] = region \wedge th[i][ord(IV1)] = 1) \longrightarrow_L th[i][ord(IV2)] + 1 = n)$ 
}
pred ihogaresEnPosicion_i (in th :  $eph_h$ , in region:  $\mathbb{Z}$ ) {
   $(\forall i : \mathbb{Z})(0 \leq i < |res|) \longrightarrow_L$ 
   $res[i] = \sum_{j=1}^{|res|} \text{if } (th[j][ord(IV1)] = 1 \wedge th[j][ord(REGION)] = region \wedge th[j][ord(IV2)] = i) \text{ then } 1 \text{ else } 0 \text{ fi}$ 
}
pred pertenece (in th:  $eph_h$ , in region, in n:  $\mathbb{Z}$ ) {
   $(\exists i : \mathbb{Z})(0 \leq i < |th| \wedge_L ((th[i][ord(REGION)] = region) \wedge (th[i][ord(IV1)] = 1) \wedge th[i][IV2] + 1 = n))$ 
}

```

### 3. Ejercicio 3

```

proc laCasaEstaQuedandoChica (in th :  $eph_h$ , in ti :  $eph_i$ , out res :  $seq(\mathbb{R})$ ) {
  Pre { $encuestaValida(th, ti)$ }
  Post { $|res| = 6 \wedge$ 
         $(\forall i : \mathbb{Z})(res[i] = proporcionHacinamientoCasaCritico(i, th, ti))$ }
}

```

#### 3.1. Predicados y Auxiliares generales

```

aux proporcionHacinamientoCasaCritico (in i :  $seq(\mathbb{Z})$ , in th :  $eph_h$ , in ti :  $eph_i$ ) :  $\mathbb{R} =$ 
if #hogares(i, th) = 0 then 0 else  $\frac{\#hogaresHacinamiento(i, th, ti)}{\#hogares(i, th)}$  fi ;

```

```

aux #hogares (in i :  $\mathbb{Z}$ , in th :  $eph_h$ ) :  $\mathbb{Z} =$ 
 $\sum_{j=0}^{|th|-1}$  if th[j][ord(REGION)] = i  $\wedge$  th[j][ord(IV4)] = 1 then 1 else 0 fi ;

```

```

aux #hogaresHacinamiento (in i :  $\mathbb{Z}$ , in th :  $eph_h$ , In ti :  $eph_i$ ) :  $\mathbb{Z} =$ 
 $\sum_{j=0}^{|th|-1}$  if th[j][ord(REGION)] = i  $\wedge$  th[j][ord(IV4)] = 1  $\wedge$  hacinamientoCritico(th[j], ti) then 1 else 0 fi ;

```

```

pred hacinamientoCritico (in hogar :  $seq(\mathbb{Z})$ , in ti :  $eph_i$ ) {
  aglomeracionesMenos500(hogar)  $\wedge$  proporcionPersonasCuartos(hogar, ti)
}

```

```

pred aglomeracionesMenos500 (in hogar :  $seq(\mathbb{Z})$ ) {
  hogar[ord(MAS_500)] = 0
}

```

```

pred proporcionPersonasCuartos (in hogar :  $seq(\mathbb{Z})$ , in ti :  $eph_i$ ) {
  if #cuartos(hogar) = 0 then 0 else  $\frac{\#personasCasa(hogar, ti)}{\#cuartos(hogar)}$  fi > 3
}

```

```

aux #cuartos (in hogar :  $seq(\mathbb{Z})$ ) :  $\mathbb{Z} = hogar[ord(IV2)]$  ;

```

```

aux #personasCasa (in hogar :  $seq(\mathbb{Z})$ , in ti :  $eph_i$ ) :  $\mathbb{Z} =$ 
 $\sum_{i=0}^{|ti|-1}$  if ti[i][ord(INDCODUSU)] = hogar[ord(HOGCODUSU)] then 1 else 0 fi ;

```

```

aux proporcionHacinamientoCasaCritico :  $\mathbb{R} =$  if #hogares(th, region) = 0 then 0 else  $\frac{\#hogaresHacinamiento(th, region, ti)}{\#hogares(region)}$  fi ;

```

## 4. Ejercicio 4

```

proc creceElTeleworkingEnCiudadesGrandes (in t1h :  $eph_h$ , in t1i :  $eph_i$ , in t2h :  $eph_h$ , in t2i :  $eph_i$ , out res :  $Bool$ ) {
  Pre { $encuestaVálida(t1h, t1i) \wedge encuestaVálida(t2h, t2i) \wedge esEncuestaAnterior(t1h, t2h)$ }
  Post { $res = True \iff hayIncrementoTeleworking(t1h, t1i, t2h, t2i)$ }
}

```

### 4.1. Predicados y Auxiliares generales

```

pred esEncuestaAnterior (in t1h :  $seq\langle \mathbb{Z} \rangle$ , in t2h :  $seq\langle \mathbb{Z} \rangle$ ) {
  ( $\forall hogar1, hogar2 : seq\langle \mathbb{Z} \rangle$ )( $hogar1 \in t1h \wedge hogar2 \in t2h \implies$ 
     $hogar1[ord(HOGAÑO)] < hogar2[ord(HOGAÑO)] \wedge$ 
     $hogar1[ord(HOGTRIMESTRE)] = hogar2[ord(HOGTRIMESTRE)]$ )
}

pred hayIncrementoTeleworking (in t1h :  $eph_h$ , in t1i :  $eph_i$ , in t2h :  $eph_h$ , in t2i :  $eph_i$ ) {
   $proporcionTeleworking(t1h, t1i) < proporcionTeleworking(t2h, t2i)$ 
}

aux proporcionTeleworking (in th :  $eph_h$ , in ti :  $eph_i$ ) :  $\mathbb{R} =$ 
if #hogaresMas500(th) = 0 then 0 else  $\frac{\#teleworkingHogaresMas500(th, ti)}{\#hogaresMas500(th)}$  fi;

aux #hogaresMas500 (in th :  $eph_h$ ) :  $\mathbb{Z} =$ 
 $\sum_{i=0}^{|th|-1}$  if  $hogarVálidoTeleworking(th[i])$  then 1 else 0 fi;

aux #teleworkingHogaresMas500 (in th :  $eph_h$ , in ti :  $eph_i$ ) :  $\mathbb{Z} =$ 
 $\sum_{i=0}^{|ti|-1} \sum_{j=0}^{|th|-1}$  if  $hogarVálidoTeleworking(th[j]) \wedge personaViveEnHogar(ti[i], th[j]) \wedge esTeleworker(ti[i])$  then 1 else 0 fi;

pred hogarVálidoTeleworking (in hogar :  $seq\langle \mathbb{Z} \rangle$ ) {
  ( $hogar[ord(IV4)] = 1 \vee hogar[ord(IV4)] = 2 \wedge (hogar[ord(MAS_500)] = 1) \wedge (hogar[ord(II3)] = 1)$ )
}

pred personaViveEnHogar (in individuo :  $seq\langle \mathbb{Z} \rangle$ , in hogar :  $seq\langle \mathbb{Z} \rangle$ ) {
   $individuo[ord(INCODOSU)] = hogar[ord(HOGCODOSU)]$ 
}

pred esTeleworker (in individuo :  $seq\langle \mathbb{Z} \rangle$ ) {
  ( $individuo[ord(ESTADO)] = 1 \wedge individuo[ord(PP04G)] = 6$ )
}

```

## 5. Ejercicio 5

```

proc costoSubcidioMejora (in th :  $eph_h$ , in ti :  $eph_i$ , in monto :  $\mathbb{Z}$ , out res :  $\mathbb{Z}$ ) {
  Pre { $esEncuestaValida(th, ti) \wedge monto > 0$ }
  Post { $res = elCostoEs(th, ti, monto)$ }
}

aux elCostoEs (th :  $eph_h$ , ti :  $eph_i$ , monto :  $\mathbb{Z}$ ) :  $\mathbb{Z}$  =
monto *  $\sum_{k=0}^{|th|-1}$  if (th[k][ord(IV1)] = 1  $\wedge$  (th[k][ord(II2)] < ( $\#CantidadDeHabitantes(th[k], ti) - 2$ )) then 1 else 0 fi ;

aux #CantidadDeHabitantes (hogar : seq( $\mathbb{Z}$ ), ti :  $eph_i$ ) :  $\mathbb{Z}$  =
 $\sum_{j=0}^{|ti|-1}$  if hogar[ord(HOGCODUSU)] = ti[j][ord(INDCODUSU)] then 1 else 0 fi ;

```