CS 420 Mini-Test 1

Divya Thota

TOTAL POINTS

93.5 / 100

QUESTION 1

Question 1 50 pts

1.1 1.a **10 / 10**

✓ **- 0 pts** *Correct*

- 10 pts Incorrect

- 10 pts Blank

- 10 pts Invalid

1.2 1.b **10 / 10**

✓ **- 0 pts** *Correct*

- 10 pts Incorrect

- 10 pts Invalid

- 10 pts Blank

1.3 1.c **10 / 10**

✓ **- 0 pts** *Correct*

- 10 pts Incorrect

- 10 pts Invalid

- 10 pts Blank

1.4 1.d **10 / 10**

✓ **- 0 pts** *Correct*

- 10 pts Incorrect

- 10 pts Invalid

- 10 pts Blank

1.5 1.e **10 / 10**

✓ **- 0 pts** *Correct*

- 10 pts Incorrect

- 10 pts Invalid

- 10 pts Click here to replace this description.

QUESTION 2

Question 2 10 pts

2.1 2.a **5 / 5**

✓ **- 0 pts** *Correct*

- 5 pts Incorrect

- 2.5 pts Partially incorrect

- 5 pts Invalid

- 5 pts Blank

2.2 2.b **5 / 5**

✓ **- 0 pts** *Correct*

- 5 pts Expected type `nat -> nat -> Prop`

- 5 pts Invalid

- 5 pts Blank

QUESTION 3

Question 3 20 pts

3.1 3.a **4 / 4**

✓ **- 0 pts** *Correct*

- 4 pts Incorrect: Expected answer

Induction

- 4 pts Invalid

- 4 pts Blank

3.2 3.b **4 / 4**

✓ **- 0 pts** *Correct*

- 4 pts Incorrect: Expected answer **Not Provable**

- 4 pts Invalid

- 4 pts Blank

3.3 3.c **4 / 4**

✓ **- 0 pts** *Correct*

- 4 pts Incorrect: Expected answer **Easy**

- 4 pts Invalid

- 4 pts Blank

3.4 3.d **4 / 4**

✓ **- 0 pts** *Correct*

- 4 pts Incorrect: Expected answer **Easy**

- 4 pts Invalid

- 4 pts Blank

3.5 3.e **0 / 4**

- 0 pts Correct

✓ **- 4 pts** *Expected answer **Not Provable***

- 4 pts Invalid

- 4 pts Blank

QUESTION 4

Question 4 20 pts

4.1 4.a **5 / 5**

✓ **- 0 pts** *Correct*

- 5 pts Proof fails to compile

- 5 pts Incomplete proof

- 5 pts Blank

- 5 pts Invalid

4.2 4.b **5 / 5**

✓ **- 0 pts** *Correct*

- 5 pts Proof fails to compile

- 5 pts Incomplete proof

- 5 pts Blank

- 5 pts Invalid

4.3 4.c **2.5 / 5**

- 0 pts Correct

- 5 pts Blank

- 5 pts Incorrect

- 5 pts Can't use auto.

- 5 pts Invalid

✓ **- 2.5 pts** *Use of reflexivity, induction, destruct has no practical use in this proof.*

4.4 4.d **5 / 5**

✓ **- 0 pts** *Correct*

- 5 pts Tactic `assumption` fails with message: `No such assumption.`

- 5 pts Blank

- 5 pts Invalid

Mini-Test 1

Name: _____ Email: _____

1. (50 points) Check the correct answer.
   (a) (10 points) The type `nat` has a finite number of elements.
   - ◯ True
   - ☑ False

   (b) (10 points) Suppose we have assumption `H : P → Q → R → S` and the current goal is `S`. If we do **`apply`** `H`, then the goal will change to `P → Q → R`.
   - ◯ True
   - ☑ False

   (c) (10 points) In Coq, the proposition `True` and the boolean `true` are logically equivalent, *i.e.*, one can prove `True ↔ true`.
   - ◯ True
   - ☑ False

   (d) (10 points) If `H : x1 :: y1 = x2 :: y2` is a current assumption, then we know that `x1` is equal to `x2`.
   - ☑ True
   - ◯ False

   (e) (10 points) All types defined in Coq must be nonempty. In other words, for any type `A`, there is some Coq expression that has type `A`.
   - ◯ True
   - ☑ False

2. (10 points) Give the type of each of the following Coq expressions, or write "ill typed" if an expression does not have a type.
   (a) (5 points) **`fun`** `(b : bool) ⇒` **`if`** `true` **`then`** `56` **`else`** `b`

ill typed

   (b) (5 points) **`fun`** `(x y : nat) ⇒ x + 56 = y`

nat--->nat--->prop

3. (20 points) For each of the following propositions, check "not provable" if it is not provable (in Coq's core logic, without additional axioms), "induction" if it is provable only using induction, or "easy" if it is provable without using induction and without additional lemmas.
   (a) (4 points) **`forall`** `(A:Type) (l l' : list A), length (l++l') = length l + length l'`
   - ◯ Easy
   - ☑ Induction
   - ◯ Not Provable

   (b) (4 points) **`forall`** `n, n = S n`
   - ◯ Easy

- ◯ Induction
- ☑ Not Provable

(c) (4 points) `forall {A:Type}, length l = 0 → l = []`

- ☑ Easy
- ◯ Induction
- ◯ Not Provable

(d) (4 points) `In 3 [1;2;3;4;5]`

- ☑ Easy
- ◯ Induction
- ◯ Not Provable

(e) (4 points) `forall P : Prop, P \/ ~P`

- ◯ Easy
- ☑ Induction
- ◯ Not Provable

4. (20 points) Complete each proof. Your proof cannot use **auto** nor **intuition**.

(a)
```
P, Q : Prop
H : P \/ Q
H0 : ~ Q
_____________________________________(1/1)
P
```

```
Example 4a: forall (P Q: Prop) (H: PVQ) (H0:~Q),P.
Proof.
   intros.
   destruct H.
   { assumption. }
   unfold not in H0.
   apply H0 in H.
   inversion H.
 Qed.
```

(b)
```
P : Prop
H : P
_____________________________________(1/1)
~ ~ P
```

```
Example 4b: forall (P:Prop) (H:P),~~P.
Proof.
   intros.
   intros D.
   unfold not in D.
   apply D in H.
   inversion H.
Qed.
```

(c) `forall n : nat, True`

```
Example 4c: forall n : nat, True.
Proof.
   intros.
   destruct n.
   constructor.
   constructor.
Qed.
```

(d) `forall (A:Type) (x:A), [x] = [x].`

```
Example 4d : forall (A:Type) (x:A), [x] = [x].
Proof.
   intros.
   reflexivity.
Qed.
```