This doc is oriented towards STEM research fields of study, but Parts A and B are applicable to other programs / fields as well.

I organized this doc into several parts:

A. Content tips
B. Writing and mechanics
C. Structure and organization
D. Advisor Selection
E. CMU-specific advice
F. My stuff

Each section has plenty of concrete examples of what to do and what not to do, collected from the SoPs I review (edited for anonymity and to better illustrate my points). I'm continuously reviewing new SoPs and adding more examples, so maybe check back for more! Feel free to share with friends, fam, whomever you know is going through this dearly painful process, if you find it helpful!

A. Content ("Good Storytelling")

1. The purpose of your SoP is to prove you are a good candidate for the program in that ***1. You are ready!*** And ***2. You are a good fit!*** Any sentence, phrase, or word that does not work toward building this argument is useless and should be eradicated!
    - See below for example SoP structure and project-description-paragraph structure.
2. **Don't mention paper names of either your publications or cited publications**, they take up too much space and are generally incomprehensible to your average prof audience, who may or may not be in your area. (*Neural Relationship Inference for Fast Modular Meta-Learning*, anyone?) Try to use layman English. Relatedly: **use acronyms for the names of conferences** in your PhD research area of interest. your reader will likely be familiar with them.
    - Instead of saying the name, describe the work you did in that publication (See Part C below for examples)
        - "My work~~, titled *blah blippity blah*~~, is published in X conference."
        - You can include the paper name in the citation as a footer if you want. But this is actually not necessary, because you probably list the publication elsewhere in your application. If you have many

publications, it may help the reviewer identify which work described in the SoP corresponds to which publication.
    - Instead of mentioning the name of a cited paper, describe the gist of the work in a phrase if possible, 1-2 sentences if not. The more sentences you find yourself using to describe the work, the more you should reconsider whether or not mentioning this work is essential to communicating your research interests and demonstrating you are prepared for the program (rule #1, above).
3. Keep it to **2 pages!** Now, I don't believe this is a requirement for all schools, but this is a rule of thumb. You *should* be able to condense the essence of your profile into 2 pages.
4. When writing about your research projects, focus on **your delta** – YOUR contribution. Minimize background (algorithm descriptions, robot specifications, etc.) *as much as possible.* See **B.2** and **B.5** (below) for related advice.

B. Mechanics ("Good Writing")

1. **Use simple sentence structure and vocabulary. Concision is precision. no fluff! Make assertions.**
    a. Instead of: *While gaining understanding and appreciation about state-of-the-art methods, it dawned on me that despite the models' complexity, they are still far from our own visual capabilities. I found that while humans can readily generalize our knowledge, computers cannot. Right away, I wanted to improve this. I began to explore other computer vision subfields and found that computers especially struggle with visual tasks in real world environments that humans accomplish effortlessly, such as understanding dynamic scenes.*
    b. Try: *I realized that current state-of-the-art methods are still far from human visual capabilities; they especially lack the ability to understand dynamic scenes.*
        i. Notice how this one makes basically the same point without as many words. You can fit in so much more content with simple sentences.
2. **Avoid redundancy. Don't waste precious SoP space! When listing a series of items with similar meanings, pick one.**
    a. Instead of: *Curious of how vision algorithms can be inspired by our own cognitive systems, I pursued a cognitive science minor to learn about our own visual systems.*

    b. Try: *Curious about how vision algorithms can be inspired by our own cognitive systems, I pursued a cognitive science minor.*
    c. Instead of: *Efficient error detection is essential to creating robust, correct, and dynamic autonomous systems.*
    d. Try: *Efficient error detection is essential to ensuring autonomous systems can recognize and respond to out-of-distribution states*.
        i. Rather than listing vague, single-word qualities of the "system," pick one and expound on it.
    e. Instead of: "My passions for creating art and writing stories have always been an integral part of myself."
    f. Try: "I love creating art and writing stories."
        i. You say: *bleh, too plain*. I say: *naaww!!* If you think my edit is boring, try adding another sentence that goes more in depth and is interesting. *In high school, I taught myself storyboard illustration, imbuing the characters I created with the understandings I gathered from my conversations with friends in day-to-day life.* That extra sentence communicates so much more. (See rule #4 below: be specific)
3. **Minimize *adverbs*, *adjectives*, *noun phrases,* and *appositive phrases* (including *parenthetical statements*!), instead using *verbs* to convey your ideas.**
    a. Instead of: *As a freshman orientation counselor at X school, I've seen the dire need for easily-accessible mental health resources for nervous and overworked first-years.*
    b. Try: *As a freshman orientation counselor at X school, I've seen that nervous first-years need easy access to mental health resources, because they are often too burdened with their studies to spend time searching for them.*
        i. Notice how this one uses more verbs, more *doing* and less *describing.*
    c. Instead of: *From the many nonprofit clients I worked with as a paid search analyst, I have seen firsthand the importance of user experience and landing page design.*
    d. Try: *Through working with nonprofit clients as a paid search analyst, I have realized it is important to design landing pages cleanly and intuitively.*
4. **Be specific rather than general, whenever you can. Every sentence you write, ask: "Can I think of a concrete example that illustrates the assertion I just made about my capabilities?" Actions speak louder than words.**
    a. Instead of: *I've learned that inclusion means designing for overworked nurses, whose deteriorating emotional and physical states make it difficult to care for sick patients.*

b. Try: *I've learned that inclusion means creating hospital spaces to be comfortable and accommodating for nurses. For example, nurses need resting spaces within hospitals that are quiet, well-furnished, and provide a peaceful and homely environment. If nurses do not have the resources to maintain their emotional and physical well-being, they simply cannot care for sick patients.*
c. Instead of: *From the many nonprofit clients I worked with as a paid search analyst, I have seen firsthand the importance of user experience and landing page design.*
d. Try: *I have worked with the nonprofit organization XX and YY as a paid search analyst, helping them revamp their website UX and design. Through these experiences, I have learned that landing page design is essential to a successful user experience.*

5. **Use active voice; not passive voice. Make "I" and "me" the main character of your story, rather than "my abilities" or "the field" or "the problem." YOU are the main character — you are the star of the show!**
    a. Instead of: *A problem that has long interested me is that of designing a trajectory forecasting model that can perform well in diverse environmental conditions*
    b. Try: *I want to design a trajectory forecasting model that will perform well in diverse environmental conditions*
    c. Instead of: *Additionally, another goal would be to conduct project work and take elective classes within X school's affiliated hospitals*
    d. Try: *Additionally, I want to conduct project work and take elective classes within X school's affiliated hospitals.*
    e. Instead of *A desire of mine is to solicit different feedback from each of my professors to understand as many different perspectives of improvement possible within my work*
    f. Try: *I want to solicit feedback from my professors to understand different perspectives on how I can improve.*
        i. Don't worry that saying "I want" is too straightforward. More straightforward is good; it's clear and to the point.
    g. Instead of: *For example, a confusing process for payment or opacity in displaying important information that users want to find can have massive impacts on their decision to make a donation—especially for older donors who may need a more intuitive interface that makes the process more accessible.*
    h. Try: *For example, a confusing payment interface on a donation website can massively impact a potential donor's decision to follow-through with a*

donation – especially an older donor who especially may require accessible technology. Donation webpages should display the most important information for donors to know in a prominent location at the top of the page.

6. **Now, my *favorite* literary device: parallelism! Parallel structure is useful for so many things. (WIP)**
    a. Illustrating examples; emphasizing certain points.
        i. *At X school, **I hope** to learn from faculty who are conducting research in the X lab, particularly in accessibility. **I hope** to understand how NGOs and governments can improve their sites to better serve users of all abilities, ages, and backgrounds. **I'm especially excited** to take electives such as Prof. X's Y course; **I hope** to understand how she makes technology more inclusive through color schemes.*
    b. Communicating cause and effect or a sequence of events (signposting)
        i.
    c. establishing contrast.
        i.

C. Structure ("Good Organization")

Below is a suggested outline for formatting your SoP, organized into sections for a total of 2 pages (which is standard as far as I know SoPs go)

Intro (0.15-0.2 page)

- Sentence about what program you want to do in what area of research
- Sentence going more in-depth about what research ideas and areas interest you
- Sentence on what you want to do after graduation (career goals)

Paragraphs about specific experiences or research projects (1-1.25 pages)

Length of this section depends on how many project experiences you have — ideally 2-3 substantial project experiences. I only had 1, though — that just means I had to spend more time talking about the future (see below)

For each project, you should consider the following outline:

- **Introductory sentence**: "In my junior year (..., summer 2021, etc.), I worked with XX school's YY lab (..., Prof. ZZ) on WW project."

- **Problem statement and importance**: "Segmentation of human hands is central to first-person video understanding. However, supervised methods fall short because manually-annotated video segmentation data is very limited. Further, it is manually expensive to hand-annotate data."
- **Proposed solution and method**: "I addressed the problem of lack of data by using transfer learning to transfer knowledge from one domain to another. I pre-trained on the hand segmentation dataset XXX, which contains segmented images of human hands holding and manipulating various household objects, and then I fine-tuned on the target environment, which involves frames from videos of a other manipulation tasks, such as solving a Rubik's cube or folding origami.
- **Challenges you faced (important!)**: "One particular design challenge I faced was dealing with style changes between the dataset and the target domain. For example, if my model does not account for differences in lighting between my source and target domain, then segmentation performs rather poorly. To address this, I chose a fancy schmancy style translation technique which blah blah blah. This was an appropriate solution because it eliminates style characteristics of the image within a latent space while preserving the content information of the image, allowing better matching between frames from the source domain and those from the target."
    - This part is particularly important for American school admission committees. It's an American thing or something. Challenges, "grit," perseverance — shows you are a person of character and handle the PhD life. I personally think it's important too!
- **What you learned from the project, project significance, or other concluding sentence**: "This work led to a publication in blah blah conference." "This work exposed me to techniques for segmentation and representation learning in sparsely-labeled data domains." "Through this work, I learned the importance of…"

Other tips and notes:

- Use past tense for projects you have completed, and present tense for those still in progress.

Industry, TA / teaching / mentoring, and leadership experience

Only include this section if you don't have much research experience. Otherwise, it is more valuable to go deeper into your research experience. 0-0.25 pages

- If you need to prioritize, then talk about things in this order:

a. substantial class research projects (projects of lower quality than something you would do in a serious advising relationship with a grad student or professor, but still worth bragging about)
b. TA / teaching / mentorship / outreach / tutoring / leadership / other field-related experience, clubs, or extracurriculars
    - This can sometimes take higher priority than "substantial class research projects," depending on your own evaluation of its significance
    - Examples: organizing STEM science events for high school girls for SWE; organizing Machine Intelligence Club paper discussions and inviting guest speakers; writing STEM articles for the school newspaper
    - It's more important that you did substantial stuff for the organization than that the name sounds good on paper. Personally, I think listing the names of honor societies in your SoP is worthless. xD
c. Coding internship projects: software engineering projects you did during internships

Prospective school profs you want to work with

0.5-0.75 pages if your past experience does not quite match the area that you want to work in or you don't have much research experience (only 1 non-first author paper or something)
0.25-0.5 pages if you have a decent amount of experience and the area you want to work in during your grad degree is directly related to your past experience

- For each school, identify 2-3 profs you want to work with
    - Read their papers and their students' papers
    - Identify the aspects of work you are interested in, connect it to your past experience
    - If you can, come up with a new idea you want to explore that is related to one of their projects
- This section is for demonstrating your interest and expertise in the prof's research area
- This section is especially important if you are looking to change research areas from what you did previously (during undergrad / masters)
- don't zone in too much on profs that perfectly match your research interests. definitely keep an open mind. You'll find labs are VERY collaborative esp at CMU,

and there are many students with co-advising relationships. You'll also find many profs have students in a wide variety of research areas. the students in the lab often make the lab, perhaps moreso than the prof who leads it.
- do a lot of research by reading papers of students in the labs you are interested in and reading the lab, prof, and student webpages. You might consider reaching out to students in the labs to ask more specific questions about their profs; they are buusssyyy so will likely not answer but it might be worth a shot if you're extra polite and specific. students are the best source of info about the profs as they are undergoing the experience that you might have if you enter their lab.

D. Selecting an Advisor

During interviews, profs will generally ask you questions to determine if you are a *good fit*, aka:

1. work style fit. is the prof more hands on? hands off? will you be more willing to follow the prof's direction or to be more independent? Will you be a workaholic and always on slack? How do you grind?
2. research direction fit. this one I feel is less important than most people tend to think, bc most profs, especially older profs who have advised more and thus a greater variety of students and thus have a wide variety of topics they would be capable and happy to advise on. Most profs want their labs to be more diverse so their students can help each other and form collaborations with each other. Depending on the existing students in their lab, profs could be looking for new students to fill in deficiencies, e.g. if a vision prof already has a lot of students doing 3D reconstruction, they may look for a student doing AV perception. Or already has a lot of students doing vision, maybe a more independent student who is more robotics-oriented.
3. fill in other deficiencies in the lab. Depending on the existing students in their lab, profs could be looking for e.g. a systems person who knows how to manage machines and could help with system admin work, a more sociable person who will add color and dimension to the lab (haha), a ethnic minority to round out lab diversity… many things that vary from prof to prof.

I personally did not have any interviews before I was accepted to CMU, and I was not given any interviews nor accepted anywhere else, so of course this advice is bounded by my limited experience.

E. CMU-specific pointers

(WIP; will update with names and organize sometime) List of faculty
Faculty grouped by general area of research:

Graphics
Computer Vision / Robotic applications (Autonomous vehicles)
Manipulation
Field Robotics
HCI
ML

Identify your general area(s) of interest; any of these profs listed below will probably be a good fit for YOU. That's because the advisor-advisee ***relationship fit*** is more important than *perfect research fit*. Questions to ask:

- Hands-on or hands-off? (a generally good indicator: hands-off-ness increases in proportion to a function of years in professorship and prof age)
- What are the students in the lab like – what are their research habits and styles?
- Are there older students you can learn from? (and do you need that?

F. My Examples

See my SOPs for examples of the above outline in action (kinda hopefully)

- Erica's grad school SoP (written 2019) — admitted to CMU Robotics Institute PhD
- Erica's Ford Foundation Fellowship SoP (written 2021) – awarded fellowship
- Erica's NSF SoP (written 2021) — not awarded fellowship but got honorable mention

So truth be told I consider myself a pretty sucky researcher whose writing ability excels far beyond my research accomplishments. so if you feel the same, then hopefully my tips can help boost your profile and your self-confidence if just a bit! ;)

I haven't looked at the first link in three years, and the latter link in one; if I were to take another look now, I probably would hate a lot of what I wrote. (*cringe cringe D:)* My writing is changing and (hopefully) improving day-by-day! So that brings me to my last point… as dear Shakespeare says via Hamlet, *to thine own self be true!* Take my advice with the most microscopic of grains if it goes against your own writing principles or causes you to affect your voice.